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Khoshnood

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(54) **CROSSBOW WITH A CRANK COCKING AND RELEASE MECHANISM**

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F41B 5/12 (2006.01)
F41B 5/18 (2006.01)
F41B 5/14 (2006.01)

(52) **U.S. Cl.**
CPC ***F41B 5/1469*** (2013.01); ***F41B 5/12*** (2013.01); ***F41B 5/123*** (2013.01)

(58) **Field of Classification Search**
CPC F41B 5/1469; F41B 5/123; F41B 5/12
USPC 124/1, 25, 86, 88, 90
See application file for complete search history.

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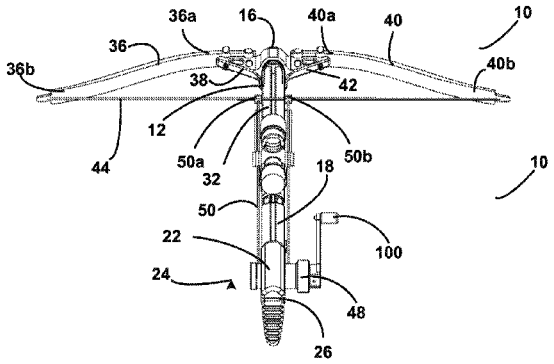
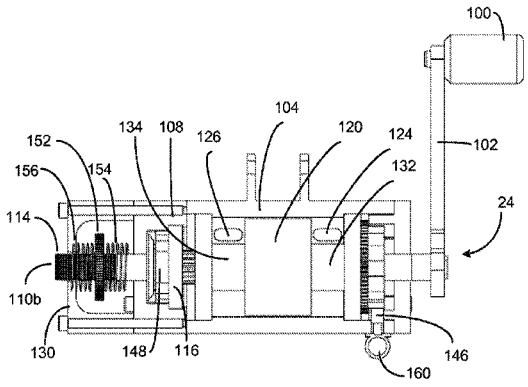
Primary Examiner — Alexander Niconovich
(74) *Attorney, Agent, or Firm* — Brient Globerman, LLC

(57) **ABSTRACT**

A crossbow bowstring drawing mechanism comprises (1) a generally cylindrical housing having a first end and a second end; (2) a shaft rotatably mounted in the housing has a first end that at least partially extends through the housing first end; (3) at least one rope spool received on, and rotationally fixed to, the shaft intermediate the shaft first and second ends; (4) a handle operatively coupled to the shaft; and (5) a clutch mechanism received on the shaft. At least one of the rope spools is configured to attach to a first and a second end of a rope that is configured to he releasably attached to a bowstring. The clutch mechanism is configured to at least temporarily rotationally fix the shaft to the housing to prevent the shaft from rotating in a first direction and an opposite second direction until a force is exerted on the handle to overcome the frictional forces exerted by the clutch mechanism.

20 Claims, 19 Drawing Sheets





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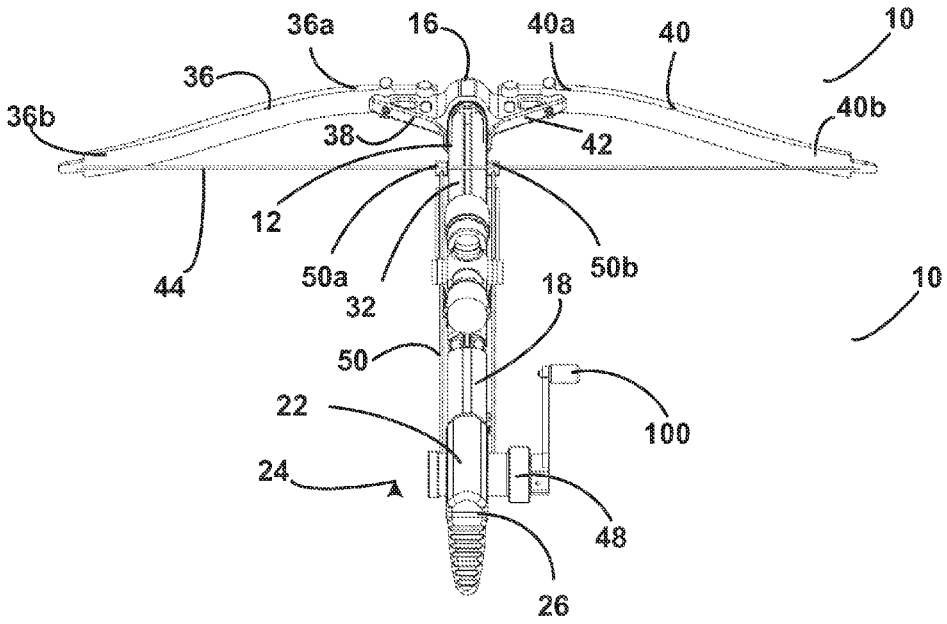
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FIG. 1

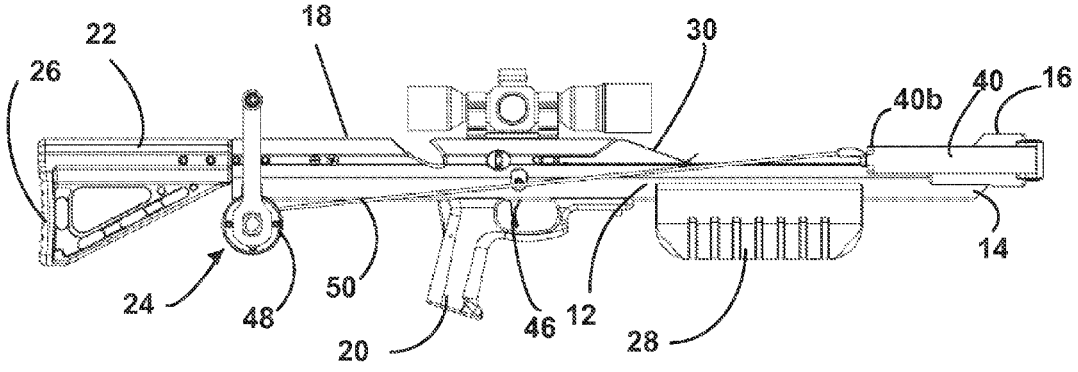
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FIG. 2

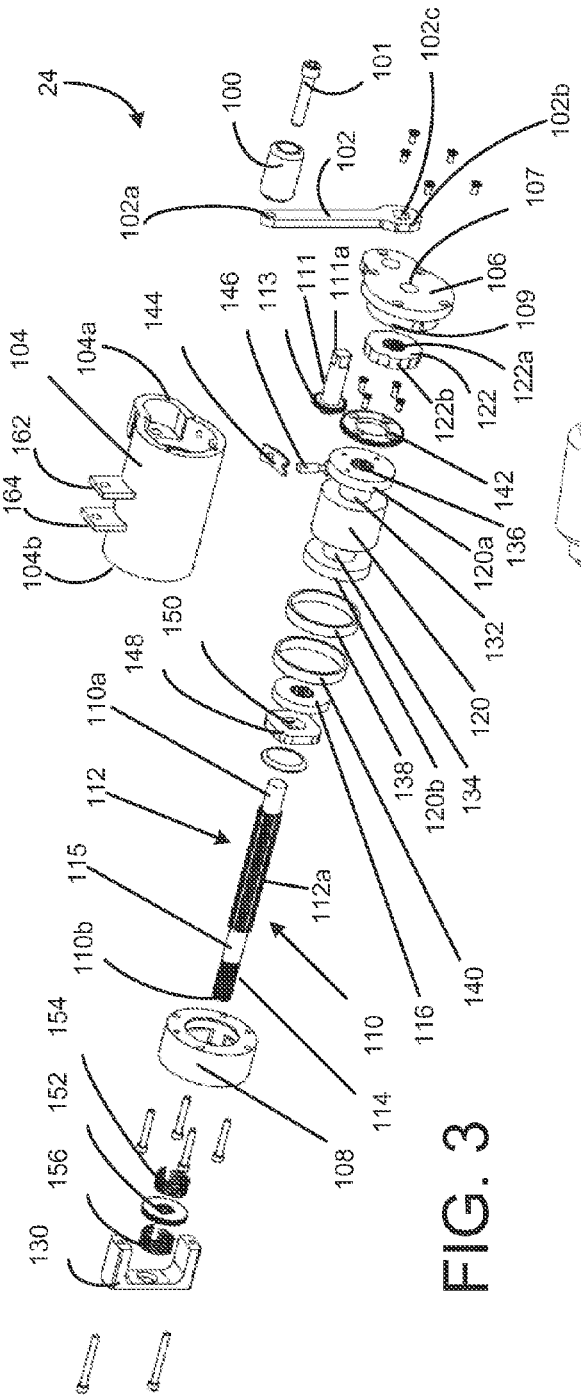
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FIG. 3

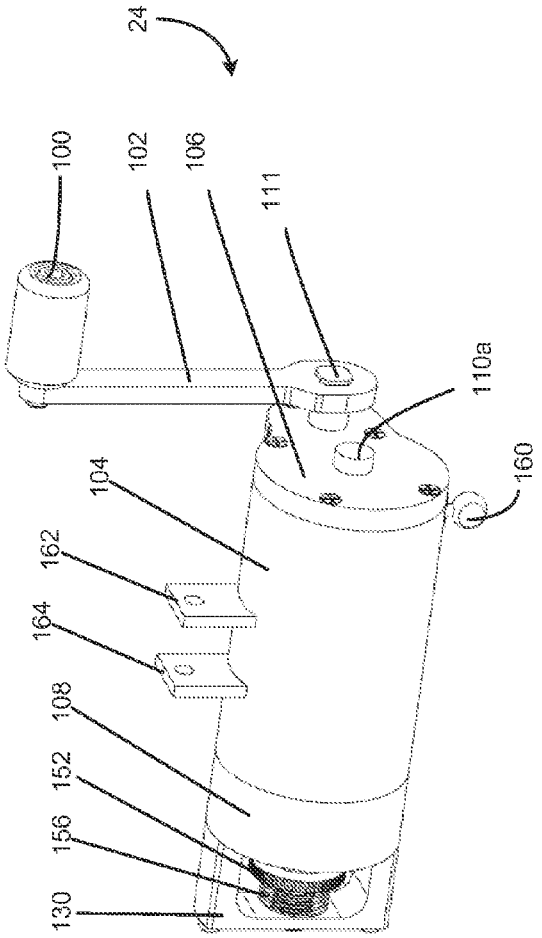
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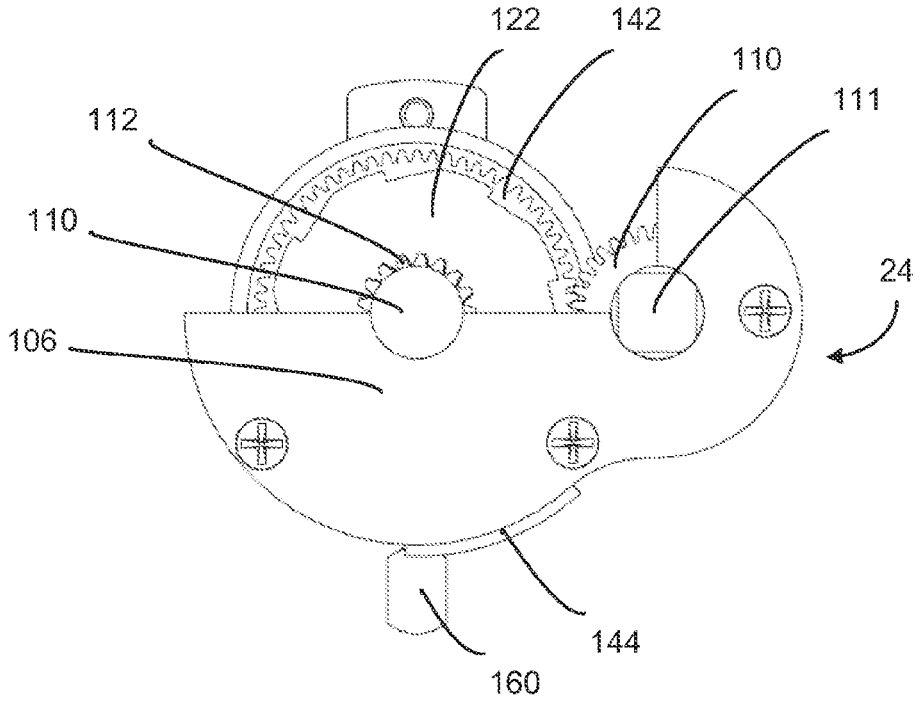
FIG. 4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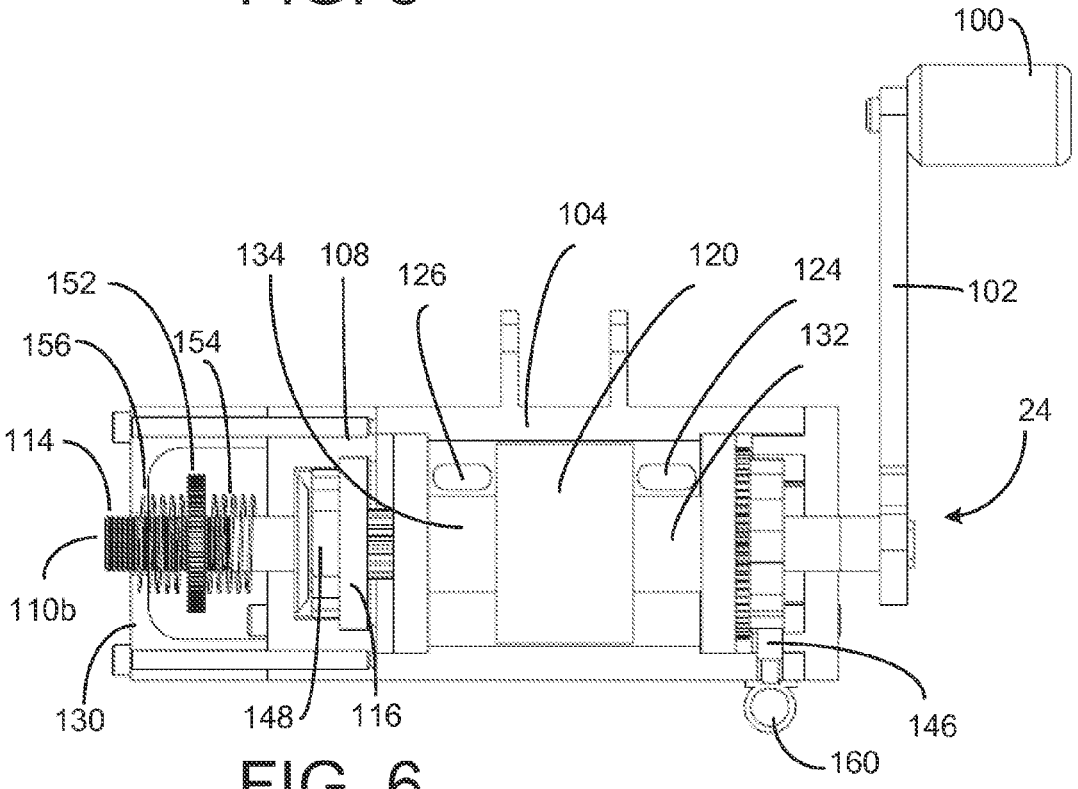
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FIG. 6

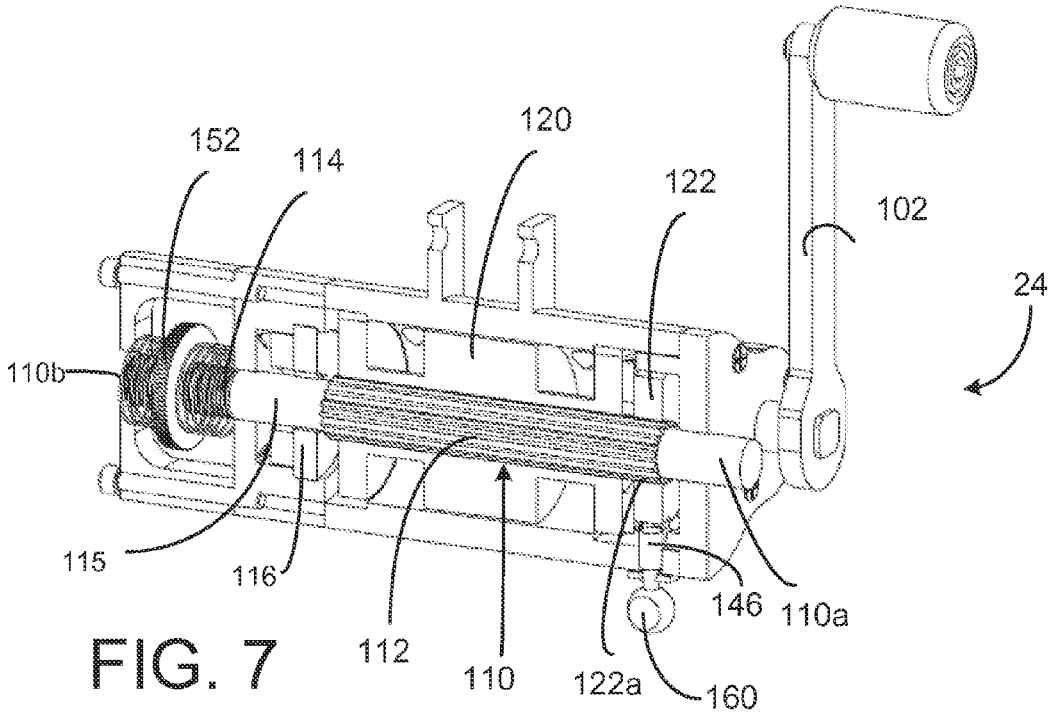
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FIG. 7

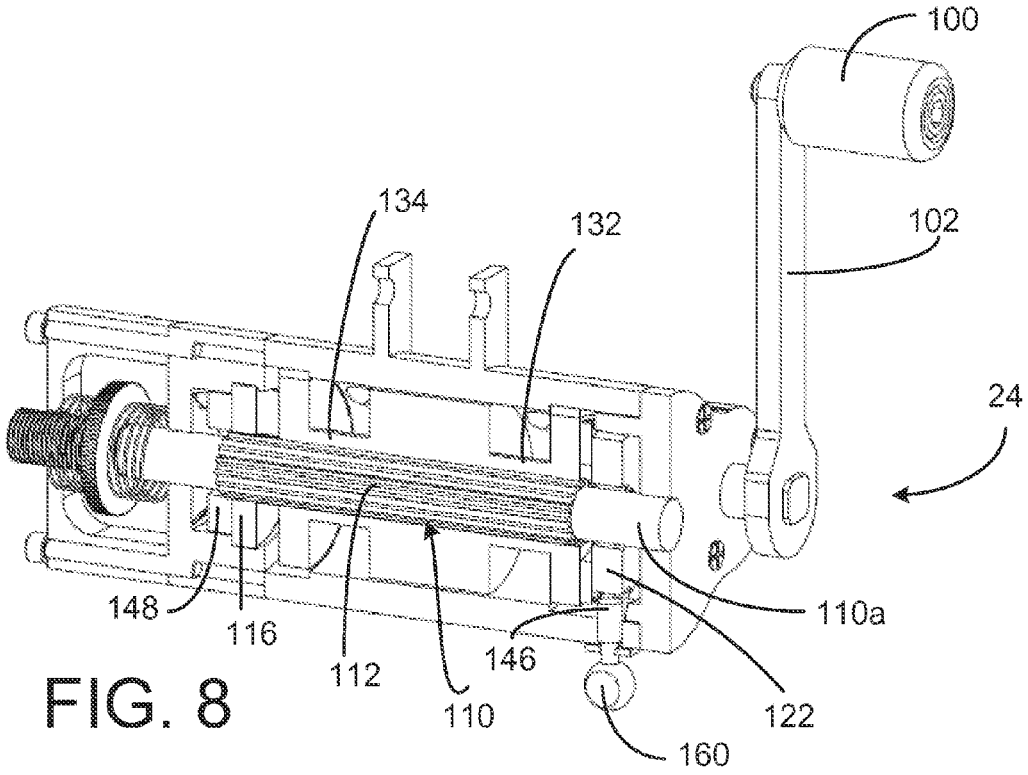
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FIG. 8

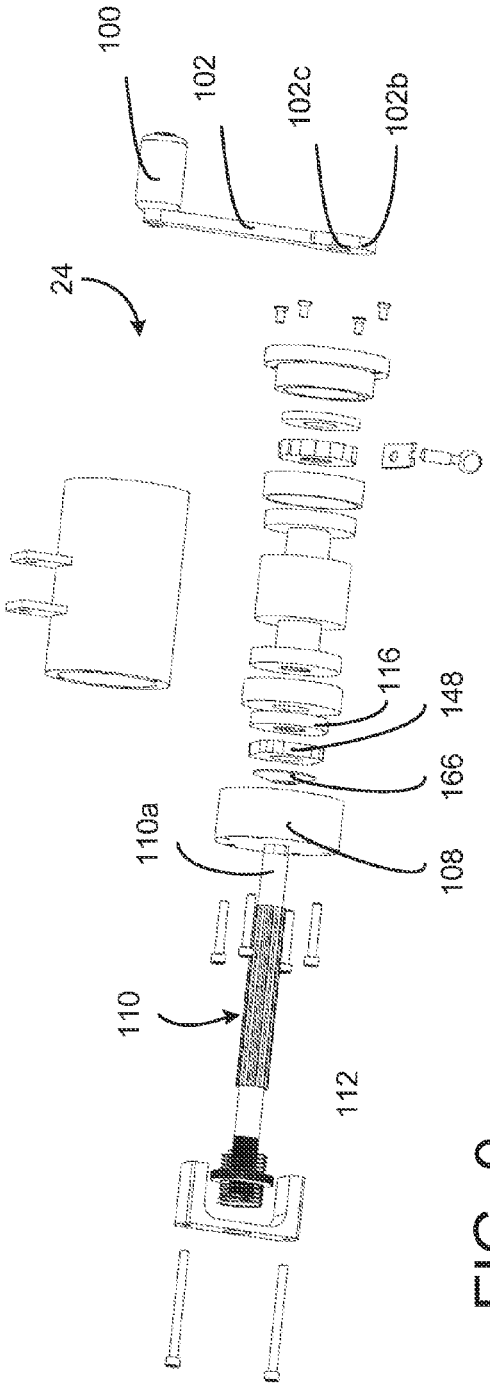
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FIG. 9

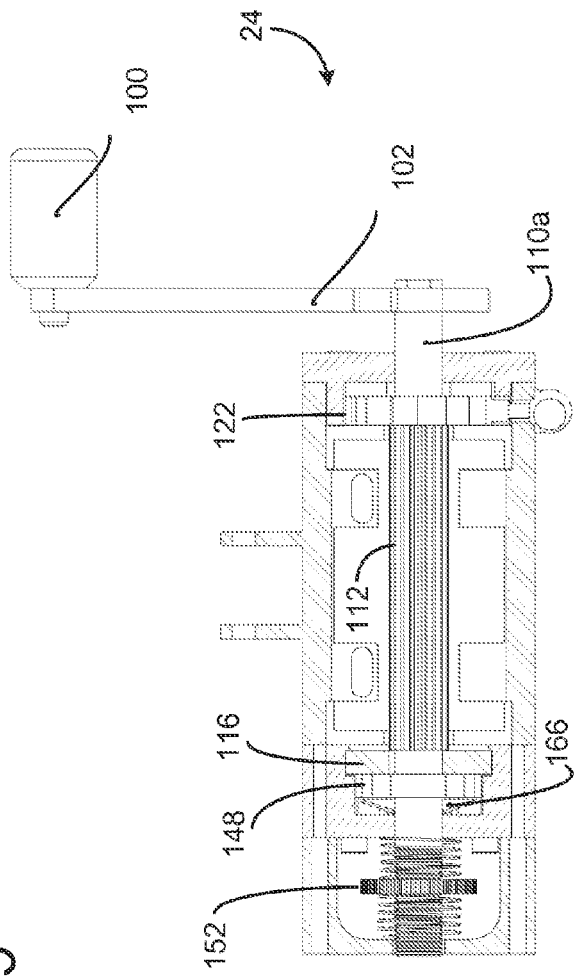
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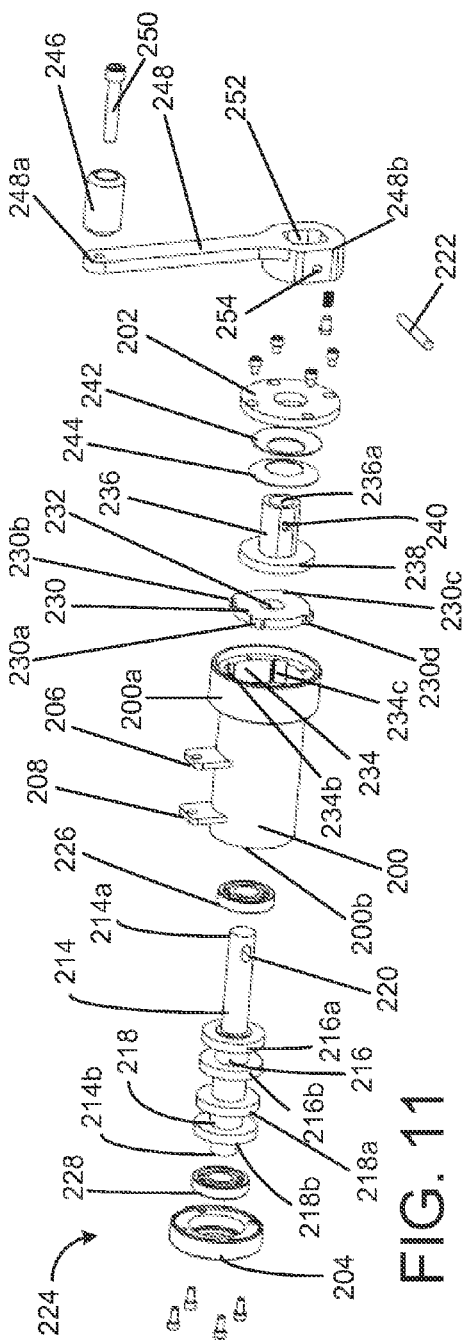
FIG. 10



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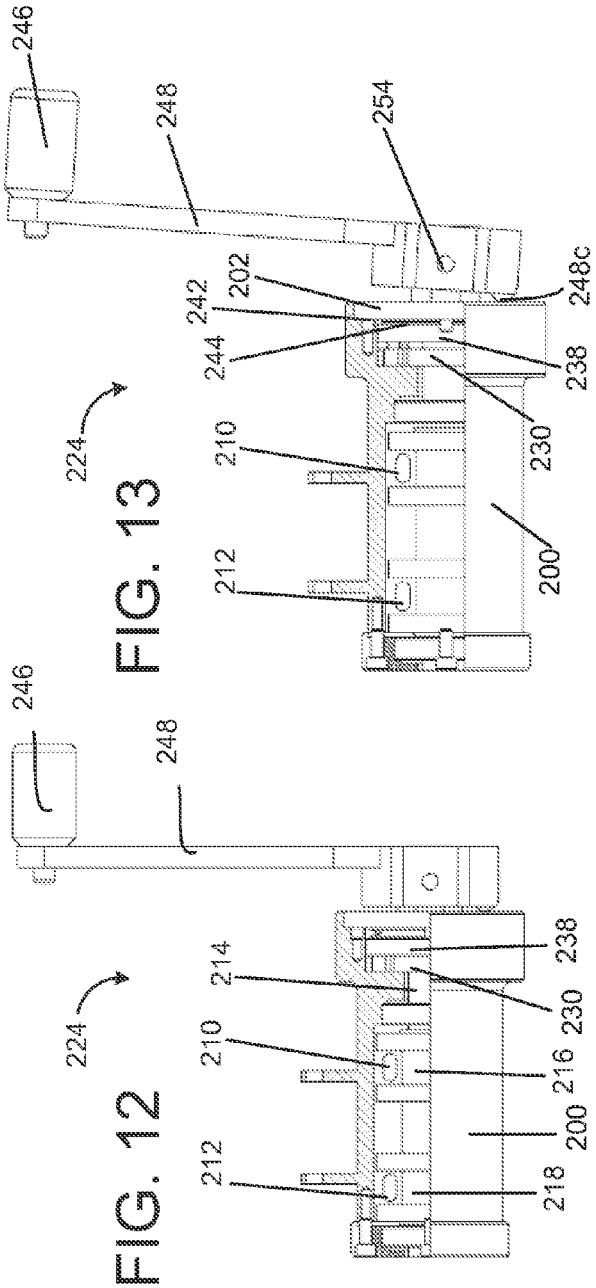

FIG. 13

FIG. 12

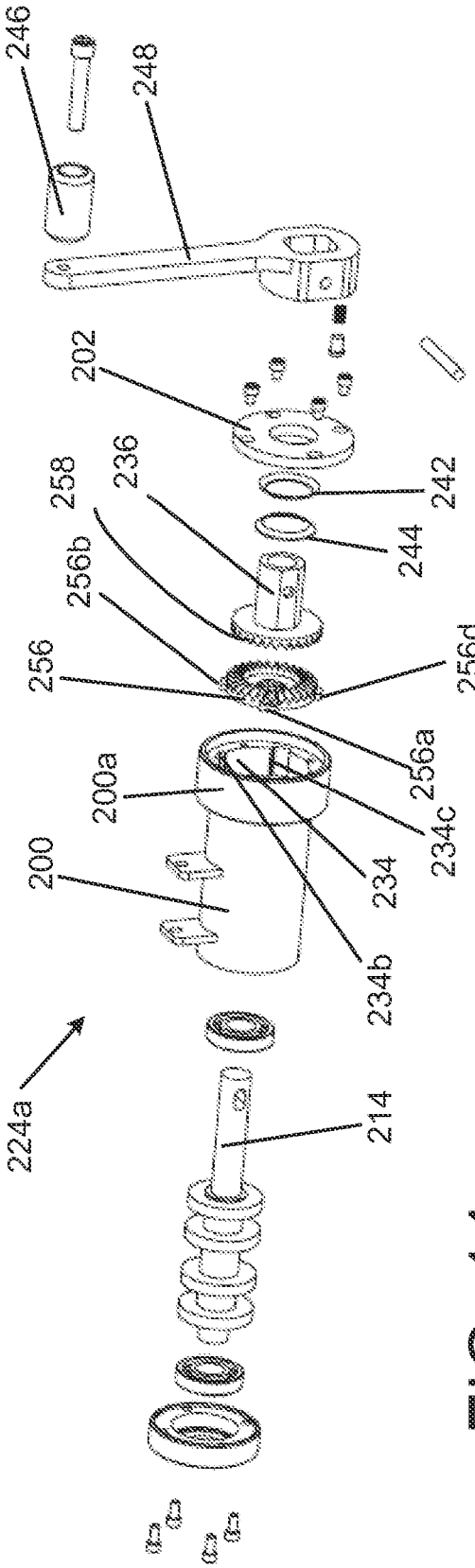
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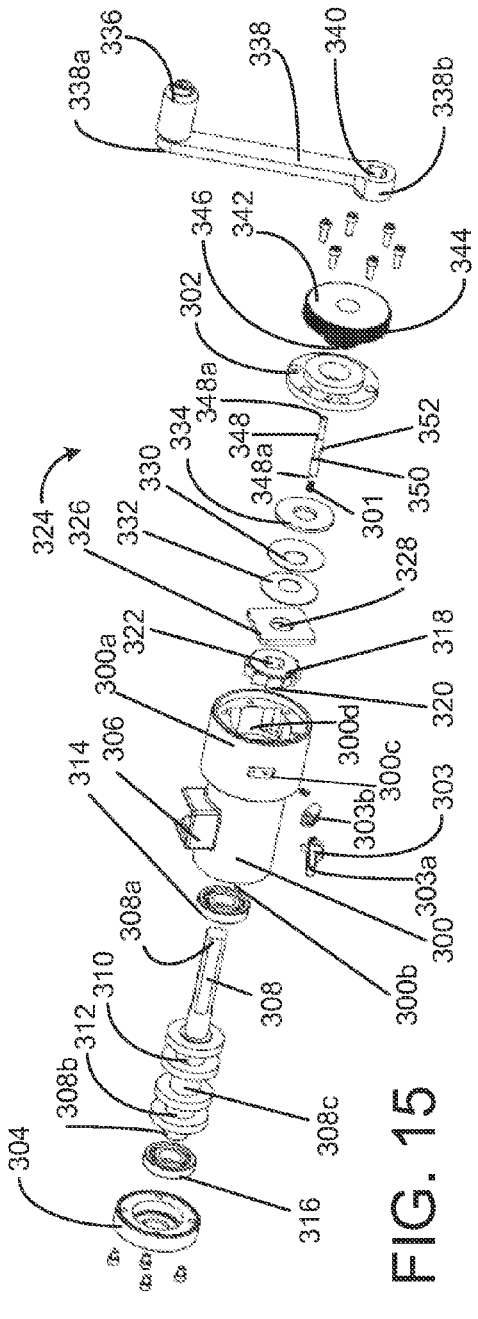
FIG. 14



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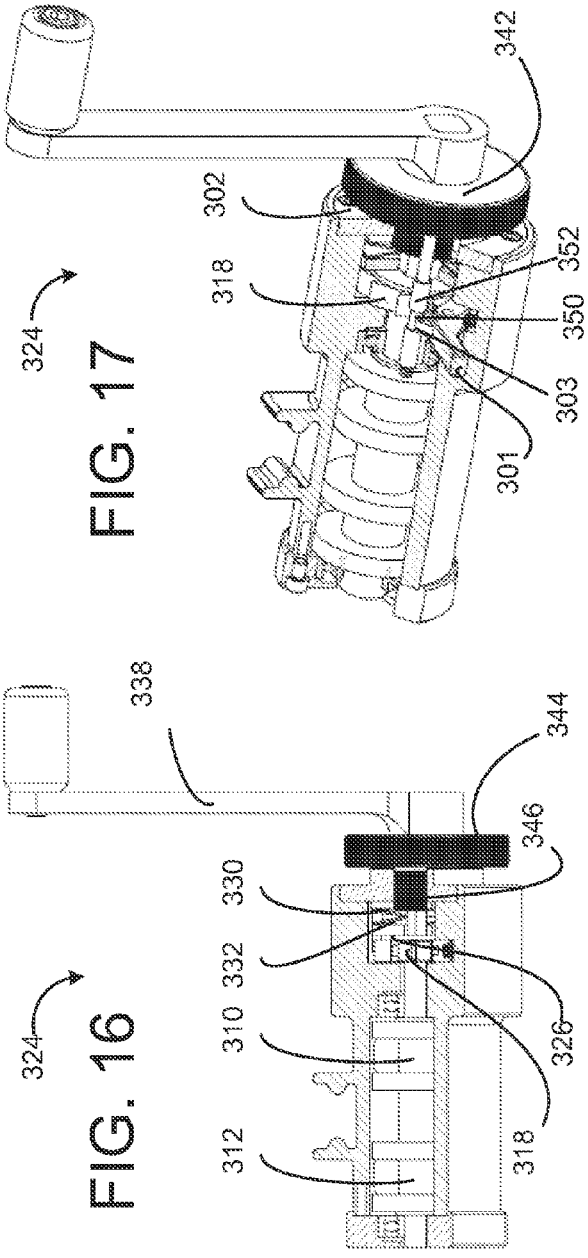

FIG. 16

FIG. 17

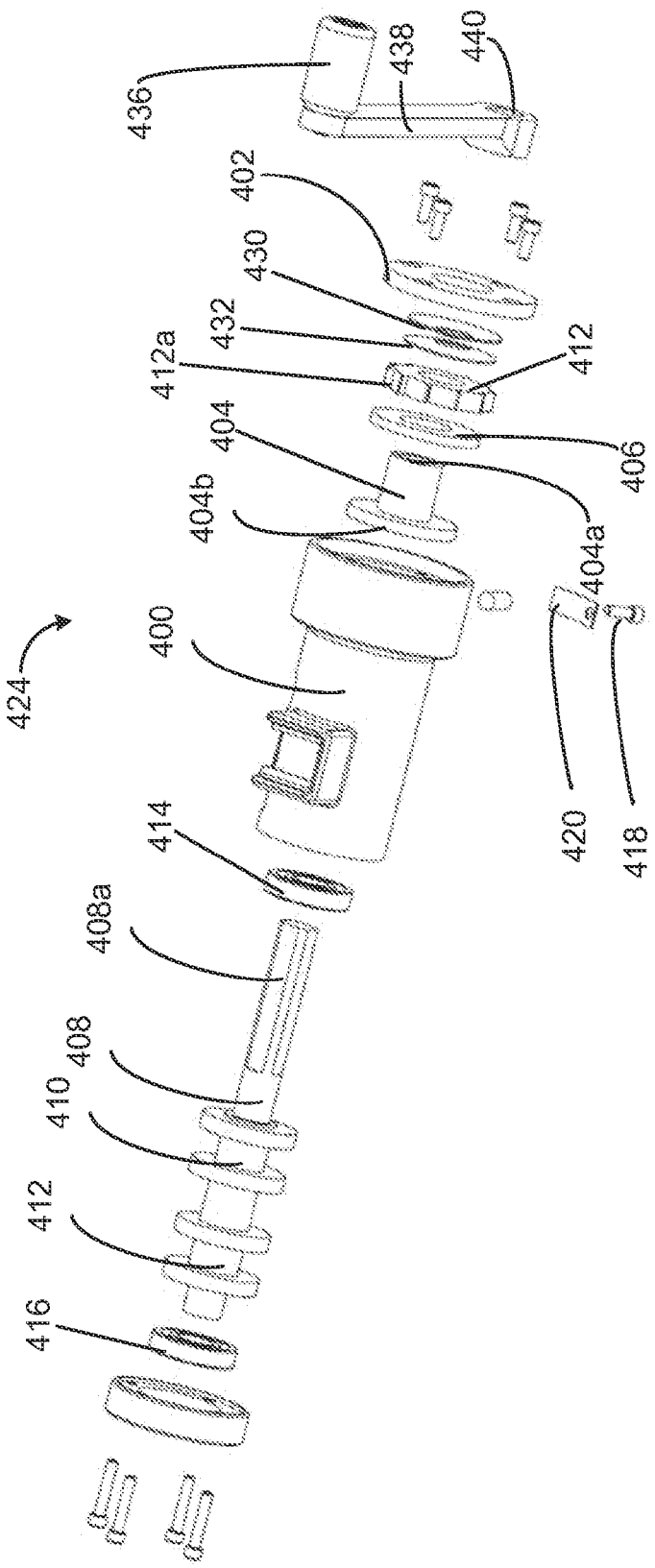
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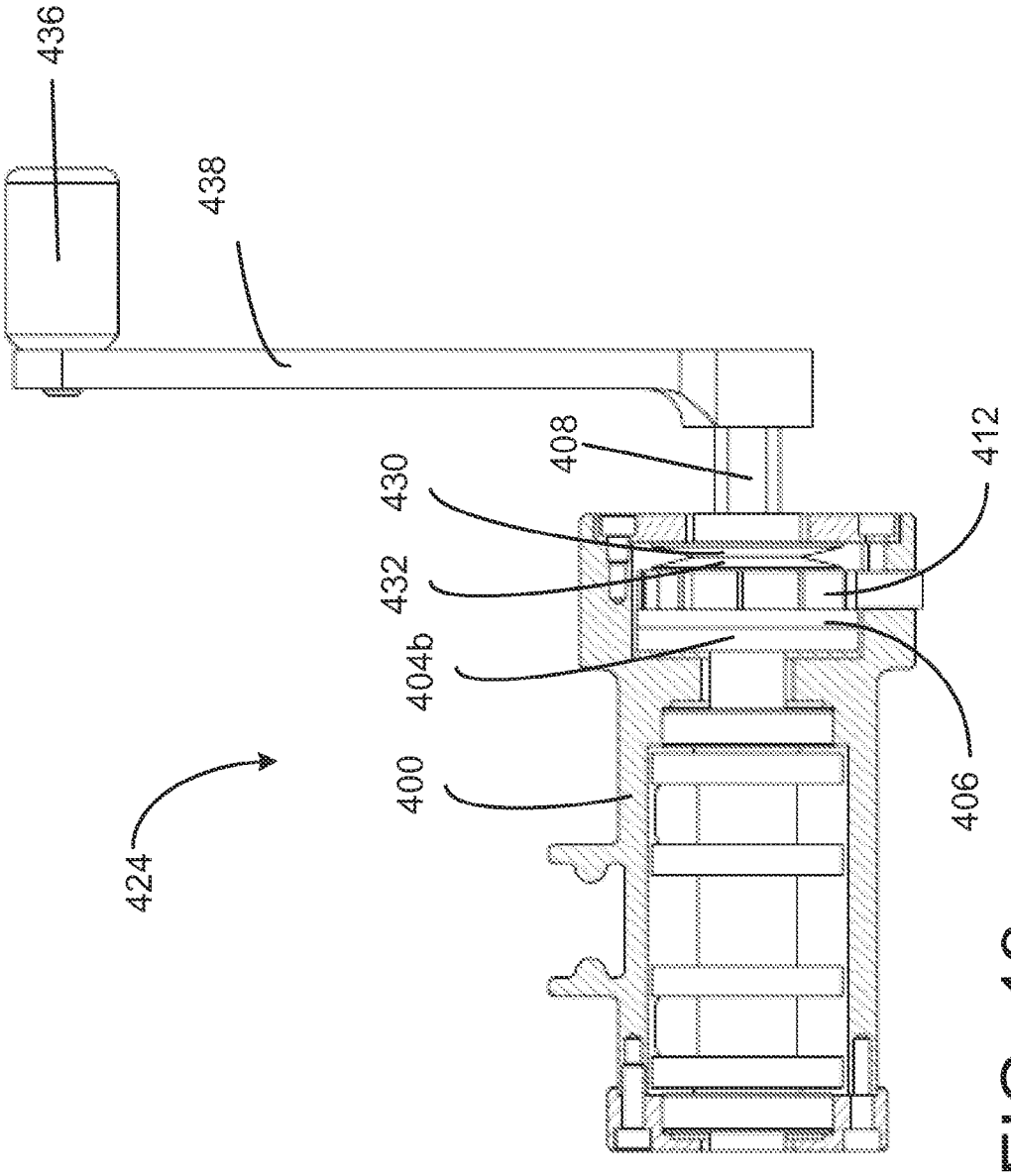
FIG. 18



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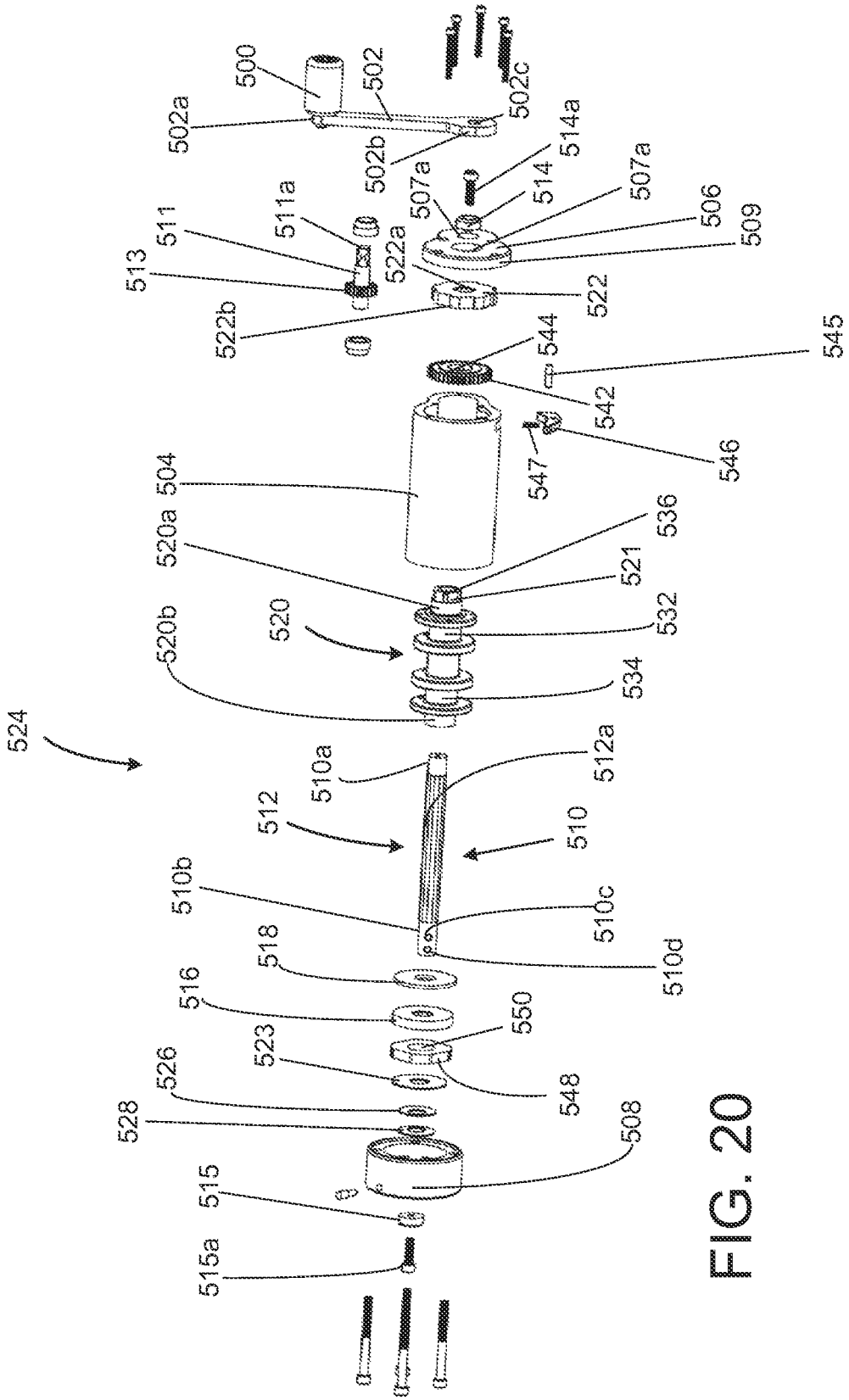
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FIG. 20

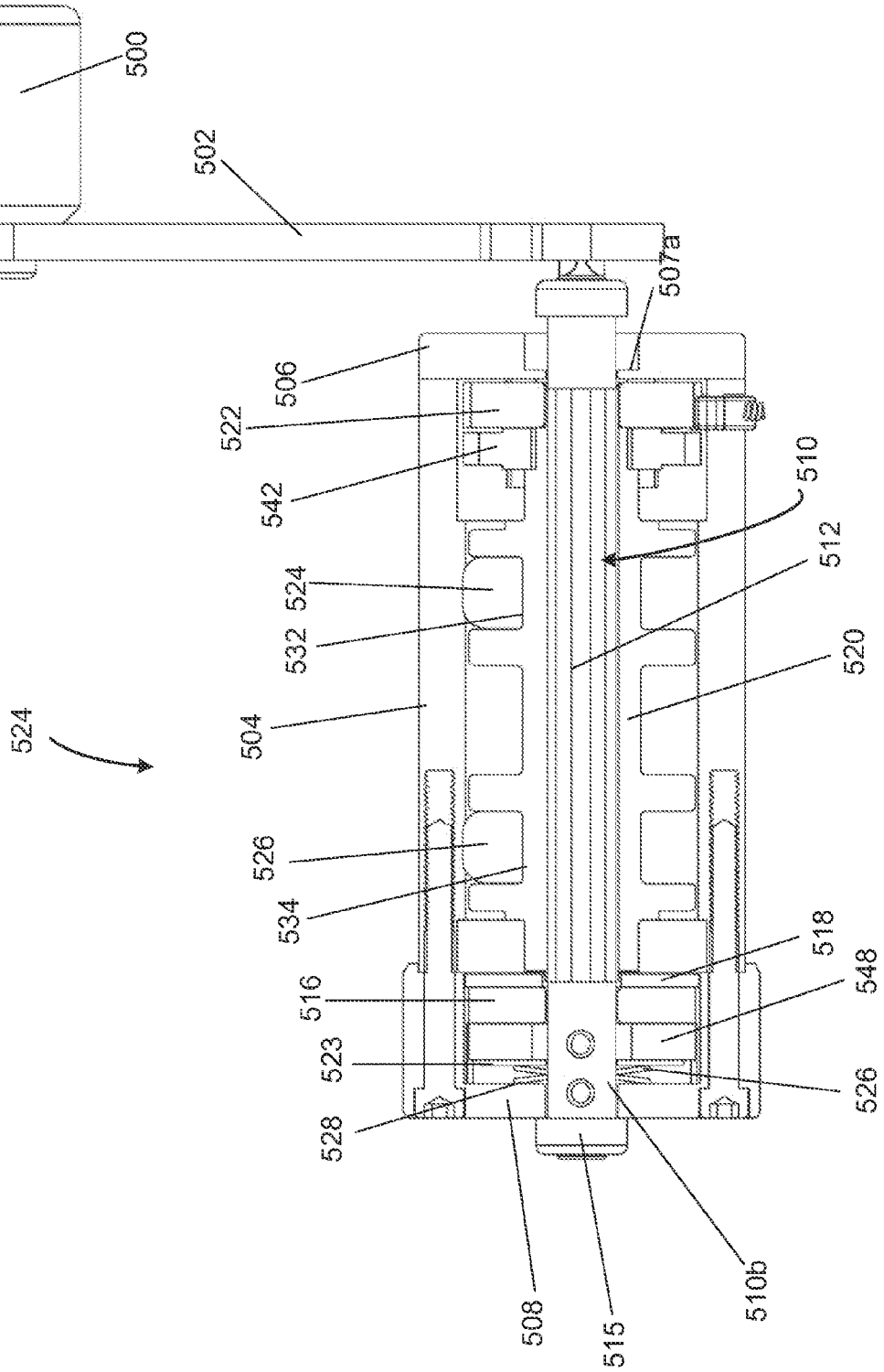
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FIG. 21

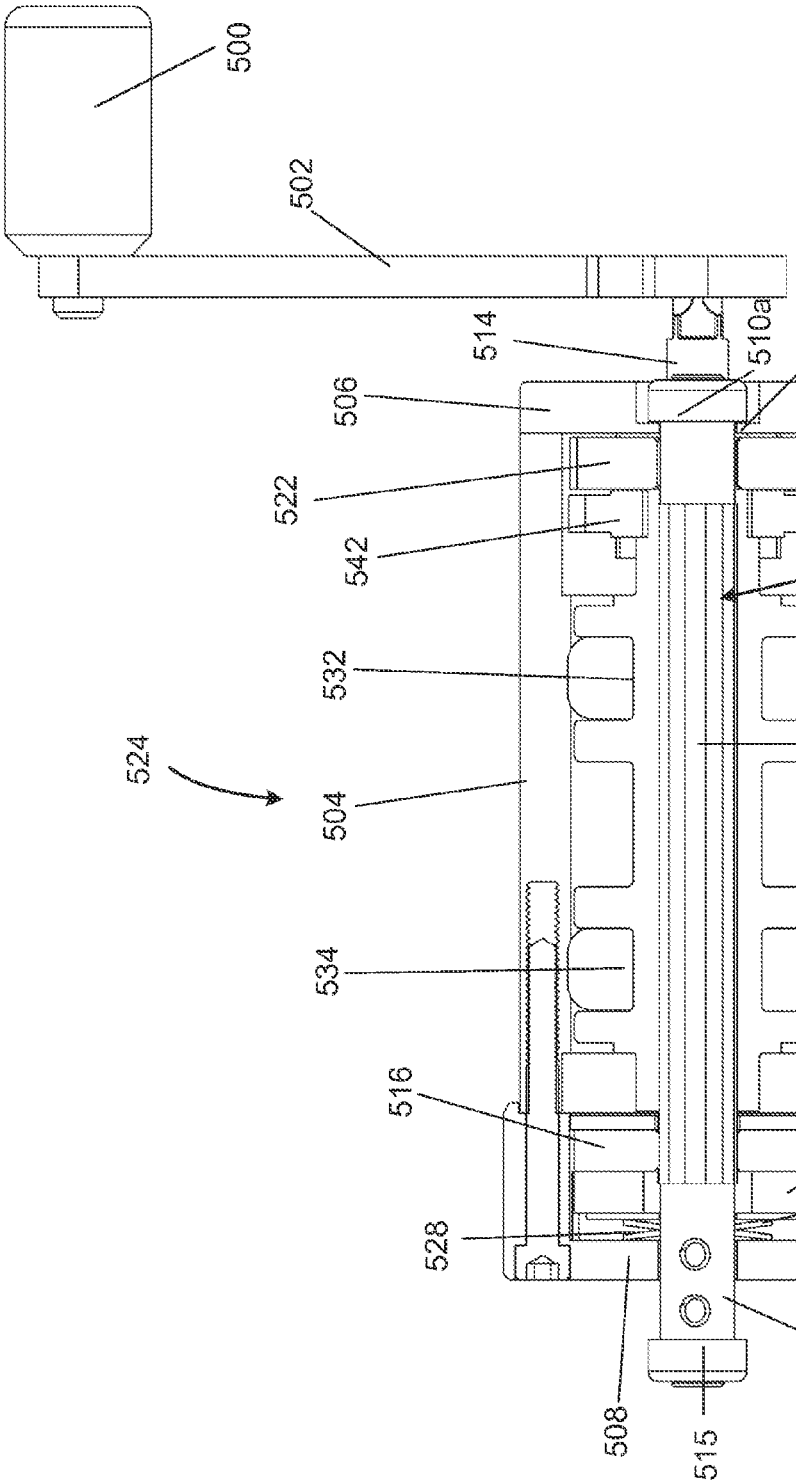
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FIG. 22

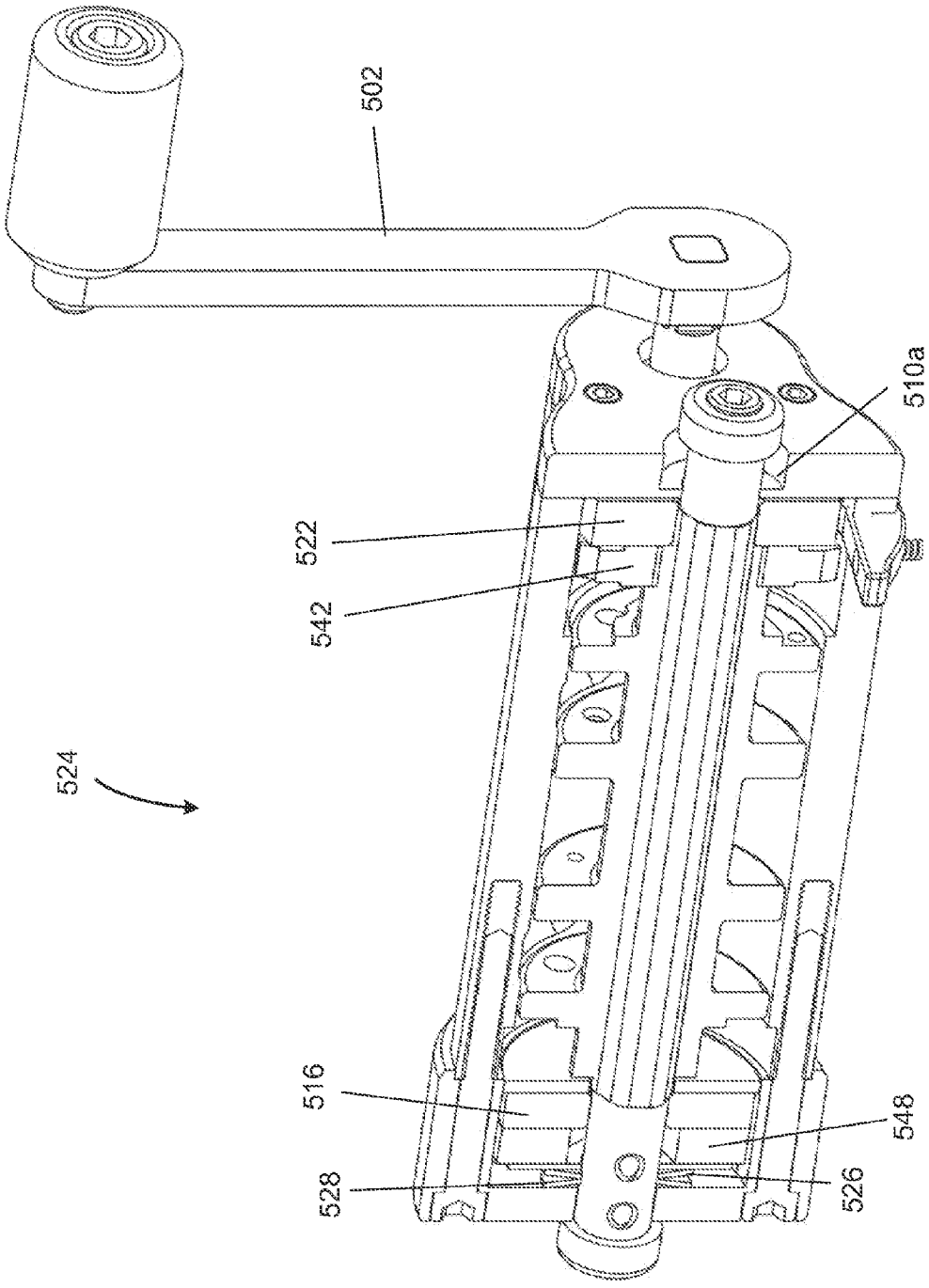

FIG. 23

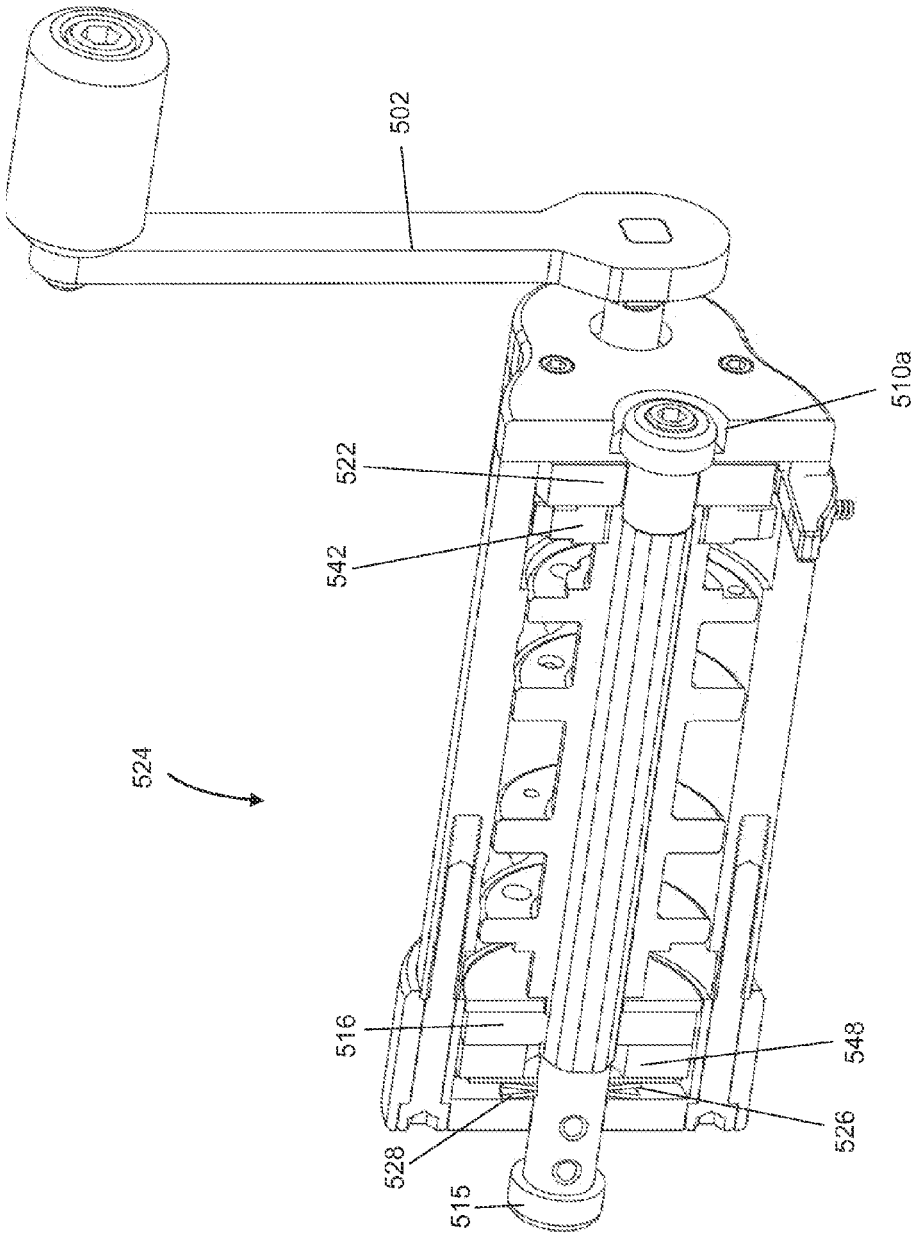

FIG. 24

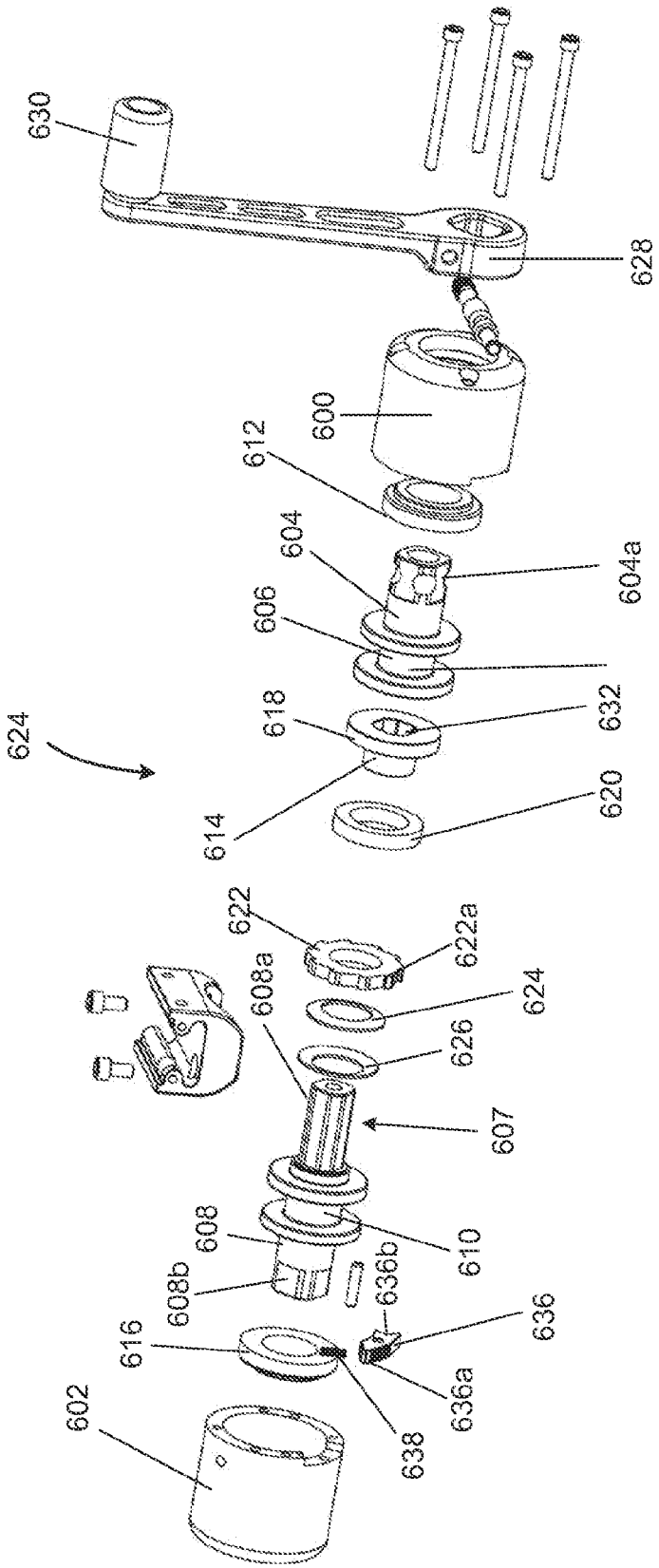
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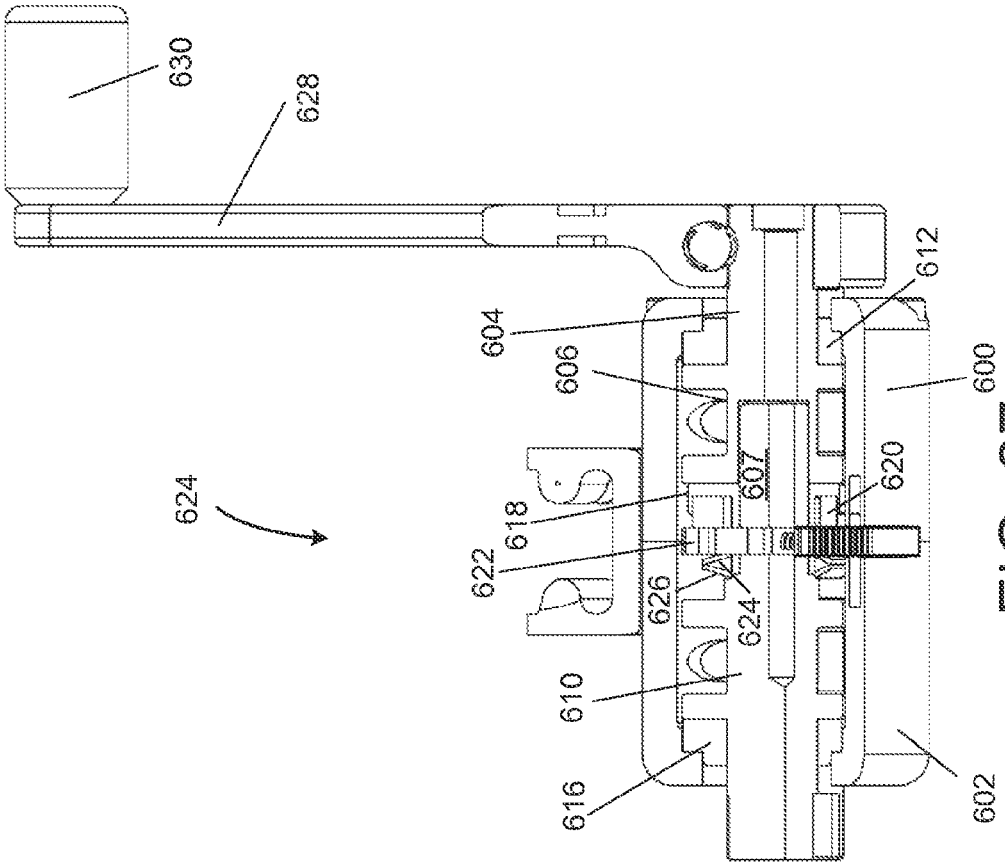
FIG. 25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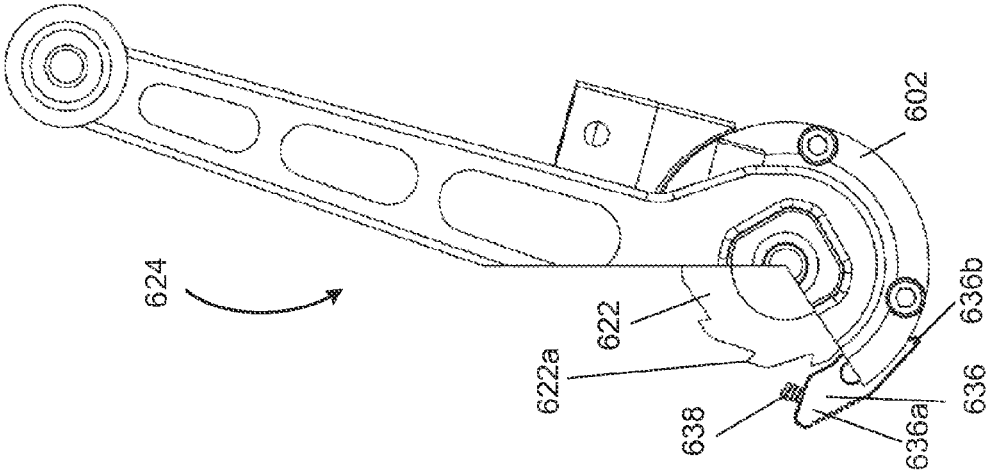
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FIG. 26

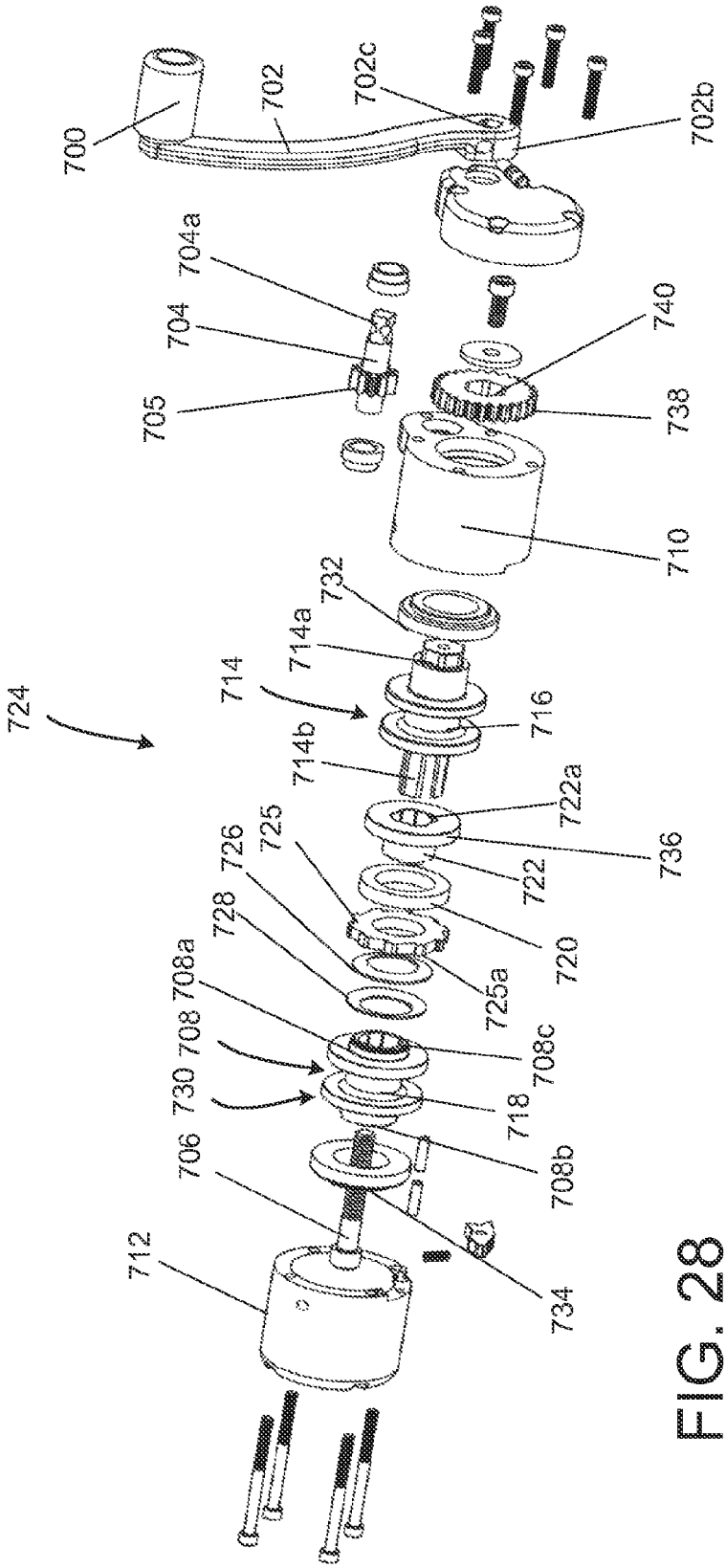
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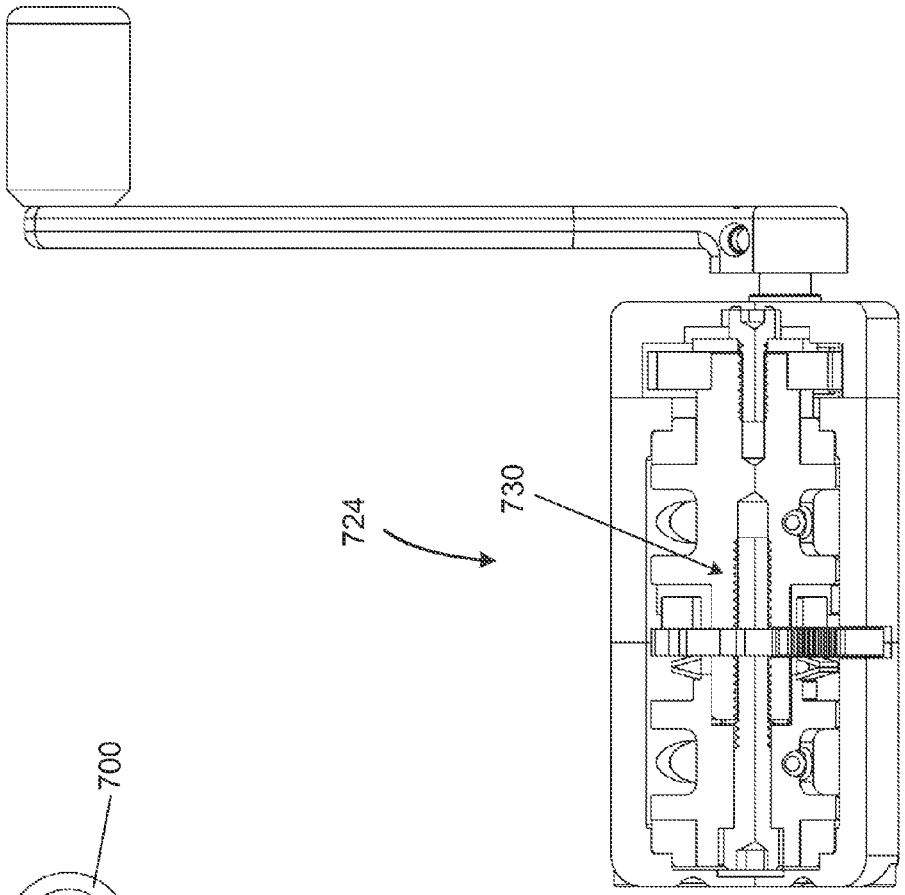
FIG. 28



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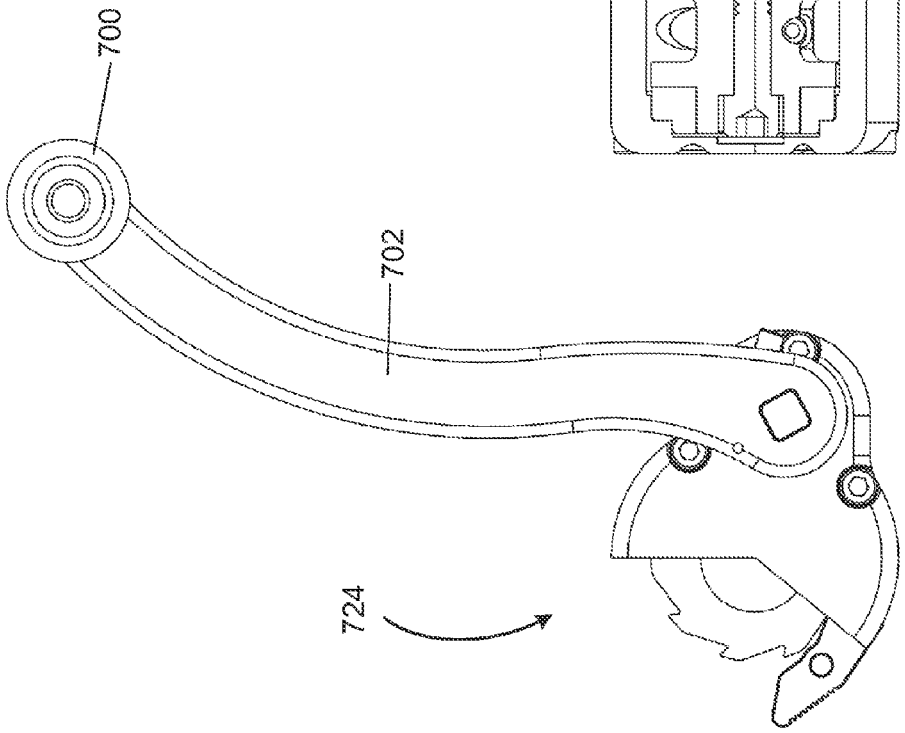

FIG. 29

CROSSBOW WITH A CRANK COCKING AND RELEASE MECHANISM

BACKGROUND

The present invention relates generally to crossbows and in particular to a release mechanism for cocking and un-cocking the bowstring on a crossbow.

Crossbows have been used since the middle ages. Crossbows have evolved to include cams and synthetic split limbs that greatly increase firing velocity. Because of the increased forces exerted by the limbs, cranks have been used to cock the bowstring. One problem encountered when using a crank mechanism to cock the bowstring arises when the user wishes to disconnect the cranking mechanism from the bowstring. Moreover, increased firing velocity also creates a problem when a crossbow is dry-fired in order to release the bowstring from a cocked position into an un-cocked position without firing a bolt or arrow. Unloaded or dry firing impacts can damage the bowstring, limbs, cams and other components. Dry firing also creates a safety concern. The designs disclosed herein seek to address many of the concerns that arise with today's crossbows.

SUMMARY OF THE INVENTION

In one embodiment, a bowstring drawing mechanism for use on a weapon comprises (1) a generally cylindrical housing; (2) a shaft; (3) a ratchet wheel that has a toothed outer circumferential surface and a splined inner circumferential surface; (4) at least one rope spool received on, axially moveable with respect o, and rotationally fixed to, the shaft; (5) a clutch mechanism received on the shaft intermediate the shaft threaded second end and the shaft axial splines; and (6) a handle operatively couple to the shaft. The shaft has (1) a first end; (2) a threaded second end; (3) an axis extending between the first and second ends; and (4) axial splines formed on an outer circumference of the shaft intermediate the first and second ends. The axial splines of the shaft are each substantially parallel to the shaft axis. A portion of the shaft is rotatably mounted in the housing. The ratchet wheel is positioned on the shaft proximate to the first end of the shaft. The rope spool is configured to attach to a first and a second end of a rope and the rope is configured to be releasably attached to a bowstring. The clutch mechanism has splines formed on an inner circumferential surface. When the shaft is in a first axial position, h respect to the clutch mechanism and the ratchet wheel, the shaft splines are engaged with the ratchet wheel splines and are disengaged from the clutch mechanism splines so that the ratchet wheel allows the shaft to rotate in a first direction and prevents the shaft from rotating in a second opposite direction. Additionally, when the shaft is in a second axial position, with respect to the clutch mechanism and the ratchet wheel, the shaft splines are disengaged from the ratchet wheel splines and engaged with the clutch mechanisms splines so that the clutch prevents the shaft from rotating in the first direction and the second direction until force is applied to the handle.

In still another embodiment, a bowstring drawing mechanism comprises (1) a generally cylindrical housing having a first end and a second end; (2) a shaft rotatably mounted in the housing has a first end that extends through the housing first end and second end; (3) at least one rope spool received on, and rotationally fixed to, the shaft intermediate the shaft first and second ends; (4) a handle operatively coupled to the shaft; and (5) a clutch mechanism received on the shaft. At least one of the rope spools is configured to attach to a first and a second

end of a rope that is configured to be releasably attached to a bowstring. The clutch mechanism is configured to at least temporarily rotationally fix the shaft to the housing to prevent the shaft from rotating in a first direction and an opposite second direction until a force is exerted on the handle.

In yet another embodiment, a bowstring drawing mechanism comprises (1) a generally cylindrical housing having a first end and a second end; (2) a shaft rotatably mounted in the housing and having a first end that extends through the housing first end, and a second end; (3) a first rope spool received on, and rotationally fixed to, the shaft intermediate the shaft first and second ends; (4) a second rope spool received on, and rotationally fixed to, the shaft intermediate the first rope spool and the shaft second end; (5) a handle operatively coupled to the shaft; and (6) a clutch mechanism received on the shaft intermediate the first and second rope spools. In various embodiments, the first and second rope spools are configured to respectively attach to a first and a second end of a rope that is configured to be releasably attached to a bowstring and the clutch mechanism is configured to at least temporarily rotationally couple the shaft to the housing.

In some embodiments, the clutch mechanism further comprises a disk rotationally fixed to the shaft, a ratchet wheel rotatably received on the shaft, and a clutch plate positioned intermediate the disk and the ratchet wheel. In other embodiments, the bowstring drawing mechanism further comprises a first gear received on and rotationally fixed to the shaft and a second shaft rotatably mounted in the housing where the second shaft has a first end coupled to the handle, and a second gear rotationally fixed to the second shaft. In some of these embodiments, the first gear is operatively coupled to the second gear so that rotation of the handle in a first direction causes the second shaft and the second gear to rotate in the first direction and the first gear and the first shaft to rotate in the opposite direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of an apparatus, system, and method for monitoring sports performance are described below. In the course of this description, reference will be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. **1** is a perspective view of an embodiment of a crossbow;

FIG. **2** is a right side plan view of the crossbow of FIG. **1**;

FIG. **3** is an exploded view of a bowstring cocking device for use with the crossbow of FIG. **1**;

FIG. **4** is a perspective view of the bowstring cocking device of FIG. **3**;

FIG. **5** is a partial sectional view of the bowstring cocking device of FIG. **3**;

FIG. **6** is a partial sectional view of the bowstring cocking device of FIG. **3**;

FIG. **7** is a partial perspective view of the bowstring cocking device of FIG. **3**, in a first position;

FIG. **8** is a partial perspective view of the bowstring cocking device of FIG. **3**, in a second position;

FIG. **9** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **10** is a partial sectional view of the bowstring cocking device of FIG. **9**;

FIG. **11** is an exploded view of an embodiment of a bowstring cocking device or use in the crossbow of FIG. **1**;

FIG. **12** is a partial sectional view of the bowstring cocking device of FIG. **11**, in a first position;

FIG. **13** is a partial sectional view of the bowstring cocking device of FIG. **11**, in a second position;

FIG. **14** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **15** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **16** is partial sectional view of the bowstring cocking device of FIG. **15**;

FIG. **17** is partial perspective view of the bowstring cocking device of FIG. **15**;

FIG. **18** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **19** is partial sectional view of the bowstring cocking device of FIG. **18**;

FIG. **20** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **21** is a partial sectional view of the bowstring cocking device of FIG. **20**, in a first position;

FIG. **22** is a partial sectional view of the bowstring cocking device of FIG. **20**, in a second position;

FIG. **23** is a partial perspective view of the bowstring cocking device of FIG. **20**, in a first position;

FIG. **24** is a partial perspective view of the bowstring cocking device of FIG. **20**, in a second position;

FIG. **25** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **26** is a partial sectional view of the bowstring cocking device of FIG. **25**;

FIG. **27** is partial sectional view of the bowstring cocking device of FIG. **25**;

FIG. **28** is an exploded view of an embodiment of a bowstring cocking device for use in the crossbow of FIG. **1**;

FIG. **29** is a partial sectional view of the bowstring cocking device of FIGS. **28**; and

FIG. **30** is partial sectional view of the bowstring cocking device of FIG. **28**.

DETAILED DESCRIPTION

Various embodiments now will be described more fully hereinafter with reference to the accompanying drawings. It should be understood that the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout.

Overview

Referring to FIGS. **1** and **2**, a crossbow **10** is shown having a barrel **12** that has a first end **14** coupled to a riser **16** and a second end **18** coupled to a pistol grip **20**. A stock **22** is coupled to the elongated barrel second end and terminates at a butt **26**. In the embodiment shown, the stock length is adjustable, but in other embodiments the stock may have a fixed length. A grip **28** is coupled to the barrel **12** intermediate the first and second ends **14** and **18**. A retention spring **30** is operatively coupled to a top surface **32** of the barrel **12**. A first limb **36** has a first end **36***a* operatively coupled to a left side **38** of the riser **16** and a second end **36***b* operatively coupled to a bowstring **44**. A second limb **40** has a first end **40***a* that is operatively coupled to a right side **42** of the riser **16** and a second end **40***b* that is operatively coupled to the bowstring **44**. A trigger mechanism **46** is used to fire the crossbow **10** when the bowstring **44** is in a cocked position.

A bowstring cocking device **24** is releasably coupled to the bowstring **44** and contains a crank mechanism **48**, an elongated cocking rope **50** having a first hook **50***a* and a second hook **50***b*. The first and second hooks **50***a* and **50***b* are configured to attach to the bowstring **44** so that when a user turns the crank **18**, the cocking rope **50** pulls the bowstring **44** into a cocked position. In general, the bowstring cocking device **24** is used to move the bowstring **44** into a cocked firing position and/or to move the bowstring **44** from the cocked firing position hack into a resting position without having to fire or dry fire the crossbow **10**. Various embodiments use a ratchet wheel and detent to allow the crank to turn in a winding first direction while preventing the crank from turning in an unwinding second direction. In various embodiments, when a clutch in the crank is engaged and the ratchet and detent disengaged, the clutch allows the crank to rotate in the unwinding second direction in a controlled manner if the user wishes to either provide slack in the elongated cocking rope **50** to remove the first and second hooks **50***a*. and **50***b* from the bowstring **44** or to move the crossbow bowstring **44** into the resting position without firing or dry firing the crossbow **10**.

First Embodiment of Bowstring Cocking Device

FIGS. **3-8** illustrate a first embodiment of a bowstring cocking device **24** having a dual shaft mechanism, a ratchet wheel, and a clutch mechanism.

Bowstring Cocking Device Structure

Referring to FIGS. **3** and **4**, one embodiment of a bowstring cocking device **24** is shown. In particular, the bowstring cocking device **24** comprises a handle **100**, a crank **102**, a housing body **104** having a first and second cover **106** and **108**, a shaft **110**, a spool body **120**, a ratchet wheel **122**, a gear **142**, a clutch mechanism **148**, and a knob **152**.

Housing Body

The first cover **106** and the second cover **108** together enclose the various parts of the bowstring cocking device **24** within the housing body **104**. The housing body **104** is generally cylindrical in shape, but may be formed in any suitable shape. In various embodiments, the housing **104** may be formed from any suitable material (e.g., alloy, stainless steel, ceramic, polymers, etc.) and in particular embodiments the housing **104** is formed from aluminum. A first mounting bracket **162** and a second mounting bracket **164** are coupled to the housing body **104** at a top surface and are configured to mount the bowstring cocking device **24** to the underside of the crossbow **10**, as shown in FIGS. **1** and **2**. In various embodiments, the mounting brackets may be connected tote crossbow **10** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.).

Shaft

Referring to FIG. **3**, the shaft **110** has a first end **110***a*, a second end **110***b* and a splined portion **112** intermediate the first and second ends **110***a* and **110***b*. In addition to the splined portion **112**, a threaded shaft portion **114** is positioned proximate the shaft second **110***b*. The shaft **110** also has a smooth portion **115** positioned intermediate the splined portion **112** and the threaded portion **114**. The splined shaft **110** is generally cylindrically shaped with the axial splines **112***a* formed on an outer circumference of the shaft intermediate to the first end **110***a* and the second end **110***b* where each axial spline is substantially parallel to the axis of the shaft **110**.

The shaft **110** is rotatably mounted in the housing **104** so that the shaft first end **110***a* extends through a hole **107** formed through the first cover **106** and the shaft second end **110***b* extends through the second cover **108**. The splines **112***a* are configured to interact with a splined ring **116**, a splined inner circumference bore **136** of the rope spool body **120**, and a splined inner circumferential surface **122***a* of the ratchet wheel **122**. The second end **110***b* of the shaft **110** passes through the second cover **108** of the housing body **104** where the threaded end **114** is configured to receive a first spring **154**, a threaded knob **152**, a second spring **156**, and a knob bracket **130**.

Rope Spool Body

The rope spool body **120** comprises a first end **120***a* and a second end **120***b*. The rope spool body **120** is generally cylindrical in shape and has a first rope spool **132** and a second rope spool **134**. The rope spools **132**, **134** provide a space for the cocking rope **50** to wind around when the bowstring **44** is pulled from the resting position into the cocked position. The rope spool body **120** is received on, axially moveable with respect to, and rotationally fixed to the shaft **110** by the splined bore **136** formed through the rope spool body **120**. In addition, the rope spools **132** and **134** are configured to operatively attach to a first and a second end of the cocking rope **50**. A first bearing **138** encompasses the first end **120***a* of the rope spool body **120** and a second bearing **140** encompasses the second end **120***b*. The bearings **138**, **140** help the rope spool body **120** rotate smoothly when the rope spool body **120** is rotated within the housing body **104**. Referring to FIG. **6**, a first opening **124** and a second opening **126** in the housing body **104** are positioned above the first rope spool **132** and the second rope spool **134**, respectively, and allow the cocking rope **50** (not shown) to enter the housing body **104** and wind around the rope spools **132**, **134**.

Gear

Referring again to FIG. **3**, the gear **142** is rotationally fixed to the first end **120***a* of the rope spool body **120** by screws (not numbered). In various embodiments, the gear **142** may be integrally formed with the rope spool body **120**. In still other embodiments, the gear **142** may be rotationally fixed to the shaft **110** via a splined engagement similar to the splined engagement between the rope spool body **120** and the shaft splines **112***a*.

Ratchet Wheel and Detent

The first cover **106** of the housing body **104** has a circular flange **109** that defines a recess (not shown) that is configured to receive the ratchet wheel **122** therein. The ratchet wheel **122** has (1) the splined inner circumference surface **122***a* and is received on the shaft splined portion **112**, and (2) a toothed outer circumferential surface **122***b*. The ratchet wheel **122** is positioned on the shaft **110** proximate to the shaft first end **110***a*. A spring **144** is operatively received in the housing **104** such that one end of the spring **144** engages a first end **146** of a button **160** that is moved into and out of engagement with the ratchet wheel toothed outer circumferential surface **122***b* to prevent unwanted rotation of the ratchet wheel **122**. The button **160** is operatively engaged with the spring **144** and allows a user to move one end of the button **146** into and out of engagement with the ratchet wheel toothed outer circumferential surface **122***b* against the bias of the spring **144**. Referring to FIG. **5**, the pin **160** is biased radially inward by the spring **144**.

Clutch Mechanism

Referring again to FIGS. **3** and **6**, the clutch **148** is received on the shaft **110** adjacent the shaft smooth portion **115**, which is intermediate the threaded shaft second end **110***b* and the shaft splined portion **112**. The clutch **148** is also received in, and rotationally fixed to, the second cover **108**. That is, the second cover **108** contains a substantially square area that receives the substantially square clutch mechanism **148** so that the clutch mechanism is rotationally fixed to the second cover **108**. It should be understood that the clutch mechanism **148** may be rotationally fixed to the second cover **108** by other suitable means. The clutch **148** has a smooth, circular inner circumferential surface **150** for receiving the shaft smooth portion **115**. In various embodiments, the clutch **148** is generally square shaped and made from Friction-modifying materials (e.g., Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material).

Adjustment Knob

The adjustment knob **152** is generally circular in shape and has a threaded inner circumferential surface that is configured to engage with the threaded portion **114** of the shaft second end **110***b*. The adjustment knob **152** is generally positioned on the shaft threaded portion **114** intermediate the second cover **108** and the knob bracket **130**. A first spring **154** is positioned intermediate the adjustment knob **152** and the second cover **108** and a second spring is positioned intermediate the adjustment knob **152** and the adjustment knob bracket **130**. The first and second springs **154** and **156** assist in biasing the shaft **110** in the axial direction depending on the position of the adjustment knob **152**, which in turn causes the splined shaft **110** to either be rotationally fixed or rotatable with one of the ratchet wheel **122** or splined ring **116** depending on the shaft's position within the following parts: the splined ring **116**, the spool body **120**, the ratchet wheel **122**, and the threaded knob **152**.

Crank Shaft, Gear and Handle

Referring once again to FIG. **3**, the handle **100** is coupled to a first end **102***a* of the crank **102** by a bolt **101**. In various embodiments, the crank **102** may be integrally formed with the handle **100**, or in other embodiments, the crank **102** may be connected to the handle **100** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.). The crank **102** and the handle **100** are generally perpendicular to each other when attached. The crank **102** also has a second end **102***b* with an opening **102***c* that is configured to operatively engage with a gear crank shaft **111**. The gear crank shaft **111** is rotationally fixed to the crank **102** since the shape of the crank opening **102***c* matches the shape of an end **111***a* of the gear crank shaft **111**. That is, the crank opening **102***c* and the end **111***a* of the gear crank shaft **111** are both substantially square in shape. In various embodiments, the crank **102** may be coupled to the gear crank shaft **111** in any suitable manner (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.).

The gear crank shaft **111** is operatively coupled to a crank gear **113** so that the gear crank shaft is rotationally fixed to the crank gear. In various embodiments, the crank gear **113** is integrally formed with the gear crank shaft **111**. In various other embodiments, the crank gear **113** may be connected to the gear crank shaft **111** using any suitable fastener (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.). The crank gear **113** has teeth that match the teeth of the gear **142**.

Parts Enclosed Inside the Housing Body

Referring to FIG. **4**, when the bowstring cocking device is assembled, the following parts fit inside the housing body **104** beginning at the first cover **106** and progressing along to the second cover **108**: the ratchet wheel **122**, the gear **142**, the rope spool body **120**, the clutch mechanism **148**, and running through the length of the inner circumference of each of these parts is the shaft **110**. Thus, in the present embodiment, the bowstring cocking device **24** has at least a portion of the following parts exposed: the handle **100**, the crank **102**, the crank gear shaft **111** exposed through the opening **102***c* of the crank **102**, the first cover **106**, the first end of the splined shaft **110***a*, the housing body **104**, the second cover **108**, and the knob bracket **130** enclosing the knob **152**, the first spring **154** (not shown), and the second spring **156**.

Bowstring Cocking Device Operation

First Position

Referring to FIG. **7**, the bowstring cocking device **24** is shown in a first position where the shaft **110** is moved axially into a first position with respect to the housing body **104** such

that the splined portion **112** is engaged with the ratchet wheel splined inner circumferential surface **122***a* o and is disengaged from the splined ring **116**. In the first position, the splined ring **116** is positioned on the shaft smooth portion **115** so that the splined portion **112** is disengaged from the splined ring **116**. The bowstring cocking device **24** may be moved into the first position as shown in FIG. **7** by turning the adjustment knob **152**. Because the knob **152** has an inner circumferential surface that is threaded, the threaded engagement of the knob **152** with the threaded end **114** of the splined shaft **110** causes the shaft **110** to move axially (toward the right with regard to FIG. **7**) so that the splined portion **112** engages with the inner circumferential splined surface of the ratchet wheel **122***a*, which causes the ratchet wheel **122** to be rotationally fixed with the shaft **110** while the splined ring **116** is allowed to rotate with respect to the shaft **110**.

Referring again to FIG. **5**, the teeth of the crank gear **113** engage with the teeth of the gear **142** so that rotation of the crank gear **113** in the clockwise direction causes the gear **142** to rotate in a counterclockwise direction (with respect to the view of FIG. **5**). Thus when the crank **102** (FIG. **6**) is turned clockwise, the gear crank shaft **111** also rotates clockwise in turn causing the crank gear **113** to rotate clockwise. This, in turn, rotates the gear **142** in the opposite, counter-clockwise, direction. Because the gear **142** is rotationally fixed to the shaft **110** via the spool body **120**, and the ratchet wheel **122** and the spool body **120** are rotationally fixed to the shaft **110**, rotation of crank **102** and crank shaft **111** clockwise causes the spool body **120** to rotate counterclockwise. As a result, as the rope spool body **120** rotates counterclockwise, it winds up the cocking rope **50** and pulls the bowstring **44** into the cocked position. Because the spring **144** biases the pin **146** into the ratchet wheel toothed outer circumferential surface **122***b*, the pin **146** prevents unwanted rotation of the ratchet wheel **122** in the clockwise direction. As a result, the spool body is also prevented from rotating in the clockwise direction since the ratchet wheel **122** and the spool body **120** is rotationally fixed to the shaft **110**. In this way, the spool body **120** will not inadvertently rotate clockwise in response to the bias exerted on the bowstring cocking rope **50** by the bowstring **44**.

Second Position

FIG. **8** shows the shaft **110** in a second position where the shaft splined portion **112** is disengaged from the ratchet wheel **122** and is engaged with the splined ring **116**. In the second position, either the bowstring cocking rope **50** may be slightly released so that the first and second hooks may be removed from the bowstring once the bowstring is in the cocked portion, or (2) the bowstring **44** may be moved from the firing position into the resting position without firing or dry firing the crossbow **10**. The bowstring cocking device is moved into the second position when the user rotates the knob **152** so that the threaded engagement between the knob **152** and the threaded shaft portion **114** causes the shaft to move axially rearward (e.g., to the left in FIG. **8**) so that the shaft splined portion **112** engages the splined ring **116** and disengages from the splined ratchet wheel **122**.

Thus, when the bowstring cocking device **24** is in the second position, the ratchet wheel **122** no longer prevents the shaft **110** from rotating in the clockwise direction since the ratchet wheel **122** is no longer rotationally fixed to the shaft **110**. Instead, the engagement of a face of the splined ring **116** with a face of the clutch mechanism **148** prevents the shaft **110** from spinning. That is, the frictional force between the face of the splined ring **116** and the corresponding face of the clutch mechanism **148** is greater than the pulling force exerted on the bowstring cocking rope **50** by the bowstring **44**. As a result, the user may turn the handle **100** and the crank **102** in the counterclockwise direction in a controlled manner, which in turn causes the shaft **110** to rotate in the clockwise direction, thereby letting the rope **50** out from the rope spools **132**, **134**. In this way, the user can either release tension on the bowstring cocking rope to allow the user to remove the first and second hooks **50***a* and **50***b* from the bowstring **44** or to release the bowstring **44** from the cocked position into the resting position in a controlled manner without firing or dry firing the crossbow.

Bowstring Cocking Device Alternate Embodiment

Referring to FIGS. **9** and **10**, an alternative embodiment of the bowstring cocking device **24** is shown having a single shaft design as opposed to the dual shaft design shown in the embodiment of Figured **3-8**. Thus, for purposes of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIGS. **9** and **10** as compared to the embodiment shown in FIGS. **3-8**. The handle **100** and crank shaft **102** couples directly to the shaft **110**. That is, the crank second end **102***b* contains a square opening **102***c* that mates with, and is rotationally fixed to, the first end **110***a* of the shaft **110**. Additionally, this alternate embodiment utilizes a concave flat spring **166** that is positioned intermediate the second cover **108** and the clutch mechanism **148** to bias the clutch mechanism **148** into the splined ring **116**. Similar to the embodiment shown in FIGS. **3-8**, the shaft **110** is moveable between a first position in which the shaft splined portion **112** is engaged with the splines funned on the inner circumferential surface of the ratchet wheel **122** and disengaged from the splined ring **116**, and the second position in which the shaft splined portion is engaged with the splined ring **116** and disengaged from the ratchet wheel **122** by rotating the adjustment knob **152** as described above.

Second Embodiment of Bowstring Cocking Device

FIGS. **11-13** illustrate a second embodiment of a bowstring cocking device **224** having a housing body **200**, a single shaft **214**, first and second rope spools **216** and **218**, a clutch mechanism **230**, a sleeve **236** and a crank **248**.

Bowstring Cocking Device Structure

Housing Body

As shown in FIG. **11**, the housing body **200** has a first end **200***a* and a second end **200***b*. Coupled to the first end of the housing body **200***a* is a first cover **202**. Coupled to the second end of the housing body **200***b* is a second cover **204**. The first cover **202** and the second cover **204** are rotationally fixed respectively to the housing body first end **200***a* and the housing body second end **200***b* by screws (not numbered) or other suitable fasteners such as bolts, rivets, weldments, etc. The first cover **202** and the second cover **204** enclose the various parts f the bowstring cocking device **224** within the housing body **200**. The housing body **200** is generally cylindrical in shape, but may be formed in any suitable shape. In various embodiments, the housing body **200** may be formed from any suitable material (e.g., alloy, stainless steel, ceramic, polymers, etc.) and in particular embodiments the housing body is formed from aluminum. The housing body **200** also has a first mounting bracket **206** and a second mounting bracket **208** for attaching the bowstring cocking device **224** to the crossbow **10**. Referring to FIGS. **12** and **13**, the housing body **200** has a first opening **210** and a second opening **212** for allowing the bowstring cocking rope **50** to pass into the housing body **200**.

Shaft, Rope Spools, and Bearings

As shown in FIG. **11**, the bowstring cocking device **224** has a shaft **214** that has a first end **214***a* and a second end **214***b*. The shaft **214** is generally cylindrical in shape. The shaft **214** also has a first rope spool **216** and a second rope spool **218** received thereon proximate to the shaft second end **214***b*. The

first spool **216** has a first end **216***a* and a second end **216***b*. In addition, the second spool **218** has a first end **218***a* and a second end **218***b*. Proximate to the first end of the shaft **214***a* is an elongated opening **220** for receiving a pin **222** as explained in more detail herein. The pin **222** is generally cylindrical in shape and may be formed from any suitable material such as aluminum, stainless steel, etc. The rope spools **216**, **218** are received on, and rotationally fixed to, the shaft **214** intermediate the shaft first end **214***a* and the shaft second end **214***b*. The rope spools **216**, **218** are configured to attach to a first and a second end of the bowstring cocking rope **50**, which is configured to be releasably attached to the bowstring **44**. In various embodiments, the spools **216**, **218** are integrally formed with the shaft. In other embodiments, the first and second spools **216**, **218** are attached to the shaft **214** using any suitable fastener (e.g., welded, screws, rivets, threaded attachment, etc.).

A first bearing **226** is received around the outer circumferential surface of the first spool first end **216***a*. Additionally, a second bearing **228** is received around the outer circumferential surface of the second spool second end **218***b*. The first and second bearings **226** and **228** allow the shaft to be mounted coaxially with a central axis (not shown) of the housing body **200** while alto Ting the shaft to rotate freely within the housing body.

Clutch Mechanism

A clutch mechanism **230** is positioned on the shaft **214** proximate to the first rope spool first end **216***a*. The clutch mechanism **230** is generally circular in shape and may be formed from friction-modifying materials (e.g., Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material). The clutch **230** has a circular inner circumference **232** for rotatably receiving the shaft **214** there through. The clutch **230** has a first tab **230***a*, a second tab **230***b*, a third tab **230***c*, and a fourth tab **230***d* that are used to rotationally fix the clutch mechanism **230** to the housing body **200**. That is, a recess **234** is formed at the first end of the housing body **200***a* and is configured to receive the clutch mechanism **230**. The clutch tabs **230***a*, **230***b*, **230***c*, **230***d* fit into a respective first tab slot **234***a* (not shown), second tab slot **234***b*, third tab slot **234***c*, and fourth tab slot **234***d* (not shown) formed around the perimeter of the recess **234**. Thus, the clutch **230** is rotationally fixed to the housing body **200** by engagement of the tabs **230***a*, **230***b*, **230***c*, **230***d* and the tab slots **234***a* (not shown), **234***b*, **234***c*, **234***d* (not shown). In alternate embodiments, any number of tabs may be used to rotationally fix the clutch mechanism **230** to the housing body **200**. In other embodiments, the clutch mechanism **230** may be rotationally fixed to the housing body **200** by other suitable affixing means such as screws, rivets, pins, etc.

Sleeve, Sleeve Disk, and Springs

A sleeve **236** is received about the shaft first end **214***a* intermediate to the clutch mechanism **230** and the first cover **202**. The sleeve **236** is generally oblong shaped and has a disk **238** coupled at the end proximate to the clutch **230**. The sleeve **236** has a substantially circular through hole **236***a* for receiving the shaft **214** and is rotationally fixed to the shaft **214** by a pin **222** that is received through an opening **240** in the sleeve **236**. The disk **238** may be integrally formed with the sleeve **236** or it may be attached to the sleeve using any suitable connecting means such as screws, rivets, pins, press fit, weldments, etc. A first spring **242** and a second spring **244** are received about the sleeve **236** intermediate the disk **238** and the first cover **202** so that the first spring **242** abuts the first cover **202** and the second spring **244** abuts the disk **238**. The first spring **242** is concave towards the first cover **202**, while the second spring **244** is concave towards the sleeve disk **238**. The springs **242** and **244** function to bias the sleeve **236** and disk **238** toward the clutch mechanism **230**.

Crank Shaft, Gear and Handle

Still referring to FIG. **11**, the bowstring cocking device **224** comprises a handle **246** and a crank **248**. The handle **246** is coupled to a first end **248***a* of the crank **248** by a bolt **250**. In various embodiments, the crank **248** may be integrally formed with the handle **246**, or in other embodiments, the crank **248** may be connected to the handle **246** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.). The handle **246** and the crank **248** are generally perpendicular to each other when attached to one another. The crank **248** also has a second end **248***b* with an oblong first crank opening **252** that is configured to operatively engage with the oblong-shaped sleeve **236** to rotationally fix the sleeve **236** to the crank **248** since the shape of the first crank opening **252** matches the shape of the sleeve **236**. That is, the first crank opening **252** and sleeve **236** are both substantially oblong in shape where the first crank opening **252** is slightly larger than the sleeve **236**. In various embodiments, the crank **248** may be coupled to the sleeve **236** in any suitable manner (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.).

The crank also has a second opening **254** that is circular in shape, formed perpendicular to the first opening **252**, and is configured for receiving the pin **222**. When the pin **222** is inserted into the second opening **254**, it passes through the crank **248**, the circular opening **240** in the sleeve **236**, and the elongated opening **220** in the shaft **214** to rotationally fix the shaft **214** and the sleeve **236** to the crank **248**. Depending upon where the pin **222** is located in the elongated opening **220** of the shaft **214**, the shaft **214** may be rotationally fixed or rotatable within the housing body **200** as described in more detail below.

Bowstring Cocking Device Operation

First Position

Referring to FIG. **12**, the bowstring cocking device **224** is shown in a first position where the crank **248** is substantially perpendicular to the shaft **214**. When the handle **246** is perpendicular to the housing body **200**, the sleeve disk **238** is pushed against the clutch material **230** by the springs **242** and **244** so that friction between a surface of the clutch mechanism and a surface of the disk **238** prevents the shaft **214** from rotating either clockwise or counterclockwise. Thus, when the bowstring cocking device **224** is in this first position, the frictional force between the clutch mechanism **230** and the sleeve disk **238** is greater than the pulling force exerted by the bowstring **44** on the spools **216**, **218** by the cocking rope **50**. As a result, the shaft **214** will not spin in either direction due to the frictional force.

Second Position

In FIG. **13**, the bowstring cocking device **224** is shown in a second position where the handle **246** is pulled away from the housing body **200**, leaving the crank shaft **248** no longer perpendicular to the shaft **214**. In particular embodiments, the user can grab the handle **246** and pull it outward, away from the housing body first end **200***a*, which causes the crank **248** to pivot about a pivot point **248***c* and angle away from the housing body **200**. When the handle **246** and crank **248** are angled as shown in FIG. **13**, the sleeve **236** and the disk **238** are moved axially toward the first cover **202** against the bias of springs **242** and **244** so that the disk **238** partially disengages from the clutch mechanism **230**. Because of the oblong opening **240** (FIG. **11**) in the shaft **240**, the pin **222** can slide within the oblong opening **240** allowing the sleeve **230** and the sleeve disk **238** to slide slightly along the length of the shaft **214** relative to the clutch mechanism **230**. The sliding

action of the sleeve **236** and sleeve disk **238** releases the frictional force between the clutch mechanism **230** and the sleeve disk **238** allowing the sleeve **230**, sleeve disk **238** and shaft **214** to rotate with respect to the housing body **200**. Thus, the user can rotate the handle in either the counterclockwise or clockwise direction from the perspective of looking toward the handle from the right in FIG. **13**. As a result, the user may turn the handle in the counterclockwise direction to move the bowstring **44** from the resting position into the cocked position. Moreover, once the bowstring is in the cocked position and is retained by the trigger mechanism, the user can release the tension on the bowstring **44** by the bowstring cocking rope **50** a sufficient amount to allow the user to remove the first and second hooks **50***a* and **50***b* from the bowstring **44**. Furthermore, should the user want to move the bowstring **44** from the cocked position to an un-cocked position without firing or dry firing the crossbow, the user may do so by moving the bowstring cocking device **224** into the second position and turning the handle **246** and crank **248** clockwise.

Second Bowstring Cocking Device Alternate Embodiment

FIG. **14** illustrates an alternative embodiment of the bowstring cocking device **224** of FIGS. **11-13**. For purposes of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIG. **14** as compared to the embodiment shown in FIGS. **11-13**. In this embodiment, the clutch mechanism **230** shown in FIGS. **11-13** is replaced with a toothed ratchet wheel **256** that is received in the housing body **200** proximate to the housing body first end **200***a*. The ratchet wheel **256** is also received on the shaft first end **214***a* intermediate the first housing spool first end **216***a* and the shaft first end **214***a*. Similar to the clutch mechanism **230** in FIG. **11**, the toothed ratchet wheel **256** in FIG. **14** has a first tab **256***a*, a second tab **256***b*, a third tab **256***c* (not shown), and a fourth tab **256***d*. The tabs **256***a*, **256***b*, **256***c* (not shown), **256***d* fit into respective tab slots **234***a* (not shown), **234***b*, **234***c*, **234***d* (not shown) of the recess **234** formed in the housing body first end **200***a* to rotationally fix the ratchet wheel **256** to the housing body **200**. The toothed ratchet wheel **256** has radial teeth formed on one face of the fixed wheel **256** facing the first cover **202**.

The sleeve **236** in this embodiment is positioned intermediate to the first cover **202** and the toothed ratchet wheel **256**. The sleeve **236** is coupled to a toothed sleeve disk **258** having radial teeth on the surface of the disk **258** facing the toothed ratchet wheel **256**. The teeth of the toothed ratchet wheel **256** oppose the teeth of the toothed sleeve disk **258** and rotationally fix the disk **258** to the toothed ratchet wheel **256**. The shape of the teeth of the disk **258** (e.g., angle of the tooth surfaces) and the force exerted by the springs **242**, **244** determine the frictional force between the toothed sleeve disk **258** and the toothed ratchet wheel **256**. That is, the frictional force must be greater than the tension force pulled on the bowstring cocking rope **50** by the bowstring **44**. The operation of the bowstring cocking device **224***a* of FIG. **14** is similar to that of FIGS. **11-13** in that in order to rotate the handle **246** an crank **248**, the user must pull the handle and crank away from the first cover **202** so that the sleeve **236** and disk **258** a pulled slightly away from the ratchet wheel **256**. In this way, the shaft **214** may be rotated with respect to the housing body **200**.

Third Embodiment of Bowstring Cocking Device

FIGS. **15-17** illustrate a third embodiment of a bowstring cocking device **324** having a single shaft **308** and a clutch mechanism **326**.

Bowstring Cocking Device Structure

Housing Body

Referring to FIG. **15**, the bowstring cocking device **324** has a housing body **300** that is generally cylindrical in shape and may be formed from any suitable material (e.g., alloy, stainless steel, ceramic, polymers, etc.). The housing body **300** has a first end **300***a* that is configured to receive a first cover **302** and a second end **300***b* that is configured to receive a second cover **304** that are coupled to the housing body using fasteners (e.g., rivets, screws, bolts, etc.) (not numbered). The outer circumference of the first end **300***a* is generally greater than the outer circumference of the second end **300***b*. Proximate to the second end of the housing body **300** is a mounting bracket **306** that is configured to attach the bowstring cocking device **324** to the crossbow **10**. The housing body also has a first opening **300***c* proximate the housing body first end **300***a*. The housing body first opening **300***c* is generally square shaped and configured to receive a detent **301** having a lever **303** formed at one end.

Shaft, Rope Spools, and Bearings

Running the axial length of the housing body **300** from the first cover **302** to the second. cover **304** is a shaft **308** that is rotationally mounted in the housing via a first bearing **314** and a second bearing **316**. The shaft has a first end **308***a* proximate to the first cover **302**, a second end **308***b* proximate to the second cover **304**, and a middle portion **308***c* intermediate to the first and second ends **308***a* and **308***b*. The shaft first end **308***a* is generally square shaped in cross section. The shaft second end **308***b* and the middle portion **308***c* are generally circular in cross section. A first spool **310** and a second spool **312** are coupled to the shaft **308** intermediate the shaft first and second ends **308***a* and **308***b*. The spools **310**, **312** are configured to attach to a first and a second end of the cocking rope **50**, respectively, which is configured to be releasably attached to the bowstring **44** by the first and second hooks **50***a* and **50***b*. In various embodiments the spools **310**, **312** are integrally formed with the shaft **308**, and in other embodiments, the spools **310**, **312** are coupled to the shaft **308** via suitable fasteners (e.g., screws, pins, weldments, press fit, etc.).

Ratchet Wheel

Positioned intermediate the first spool **310** and the shaft first end **308***a* is a ratchet wheel **318**. The ratchet wheel is received on and rotationally fixed to the shaft **308**. The ratchet wheel **318** has a toothed outer circumferential surface **320** and a generally square shaped inner circumference **322**. The ratchet wheel **318** is rotationally fixed to the shaft **308** by the interaction of the generally square shaped inner circumference **322** and the square shaped shaft first end **308***a*.

Clutch Mechanism

The clutch mechanism **326** is received in a generally square shaped recess **300***d* formed in the housing body first end **300***a* and is received on the shaft **308** intermediate he ratchet wheel **322** and the first cover **302**. The clutch **326** is generally square shaped and may be made from any friction-modifying material Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material). The shaft **308** is rotatably received through a circular center hole **328** formed in the clutch mechanism **326**. The clutch mechanism **326** is rotationally fixed to the housing body **300** since the shape of the clutch mechanism **326** matches the shape of the recess **300***d*.

Springs and Washer

A first spring **330** and a second spring **332** are received on the shaft **308** intermediate the clutch mechanism **326** and the first cover **302**. A washer **334** is received on the shaft **308** intermediate the first spring **330** and the first cover **302**. The

first spring **330** is concave towards the washer **334**, while the second spring **332** is concave towards the clutch mechanism **326**.

Handle and Crank Shaft

As shown in FIG. **15**, the bowstring cocking device **32.4** comprises a handle **336** and a crank **338**. The handle **336** is rotatably coupled to a first end **338***a* of the crank **338** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.). In various embodiments, the crank **338** may be integrally formed with the handle **336**. The handle **336** and the crank **338** are generally perpendicular to each other when attached to one another. The crank **338** also has a second end **338***b* having a generally square shaped opening **340** that is configured to operatively engage with the shaft squared first end **308***a*. The shaft **308** is rotationally fixed to the crank **338** by the interaction of the shaft square first end **308***a* and the crank square shaped opening **340**. in various embodiments, the crank **338** may be coupled to the shaft **308** in any suitable manner (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, press fit, etc.).

Safety Mechanism

A screw wheel **342**, safety **348** and a detent **303** together form a safety mechanism that allows and prevents the detent **303** from engaging the ratchet wheel teeth **320**. The screw wheel **342** has a first portion **344** and a threaded second portion **346**. The threaded second portion **346** is threadedly received in a threaded opening **302***b* formed icy the first cover **302**. Thus, the screw wheel **342** is both rotatable and axially moveable with respect to the first cover **302**. The wheel first portion **344** is positioned intermediate to the crank **338** and the first cover **302** and is, therefore, not received within the housing body **300**.

The safety **348** is positioned substantially parallel to the axis of the shaft **308** and has a first end **348***a* that abuts a surface of the wheel first portion **344**. As shown in FIGS. **15** and **17**, the safety **348** has a first end **348***a*, a recessed middle portion **350**, and a raised portion **352**. The safety **348** is positioned intermediate to the housing body **300** and the screw heel **342**. A spring **301** is positioned intermediate the housing body **300** and a second end **348***b* of the safety **348** and is configured to bias the safety **348** toward the screw wheel first portion **344**. Thus, when the wheel **342** is rotated so that it moves axially with respect to the first cover **302** toward the housing body first cover **302**, the safety **348** is biased axially toward the housing second cover **304** thereby aligning the recessed portion **350** with the detent lever second end **303***b*. If, on the other hand, the screw wheel **342** is rotated in the opposite direction so that the screw wheel second portion moves axially away from the housing body first cover **302**, the spring **301** biases the safety **348** toward the first cover **302**.

Bowstring Cocking Device Operation

Referring to FIGS. **15**, **16** and **17**, the safety **348** is moveable between a first position in which the safety raised portion **352** aligns with the detent lever **303** thereby preventing the detent lever second end **303***b* from engaging the ratchet wheel teeth **320** and a second position in which the safety recessed portion **350** aligns with the detent lever **303** thereby allowing the detent lever second end **303***b* to engage with the ratchet wheel teeth **320**. When the screw wheel **342** is rotated so that the screw wheel first portion **342** moves away from the radial face of the first cover **302**, the safety **348** is in the second position so that the safety recessed area **350** aligns with the lever **303**. In this position, engagement of the detent lever second end **303***b* with the ratchet wheel teeth **320** allows the handle **336** and crank **338** to rotate in the counterclockwise direction but prevents rotation of the handle **336** and crank **338** in the clockwise direction. Thus, the user can rotate the handle and crank counterclockwise so that the bowstring cocking rope **50** is wound onto the first and second rope spools **310** and **312** thereby pulling the bowstring **44** into the cocked position.

Once the bowstring **44** is in the cocked position where the trigger device on the crossbow **10** retains the bowstring **44** in the cocked position, the user may rotate the wheel **342** to move the screw wheel first portion **344** axially toward the first cover **302** while pressing on the detent first end **303***a* so that the safety raised portion **352** aligns with the detent lever **303** thereby preventing the detent lever second end **303***b* from engaging with the ratchet wheel teeth **320**. Additionally, as the screw wheel first portion **344** moves axially toward the first cover **302**, the screw wheel second portion **346** abuts and biases the washer **334** axially toward the first and second springs **330** and **332** thereby compressing the springs. As the first and second springs **330** and **332** compress, they exert pressure on the clutch mechanism **326** thereby increasing the frictional forces between the clutch mechanism **326** and the ratchet wheel **318**.

Thus, in the first position, friction between the clutch mechanism **326** and the ratchet wheel face **318** prevents the shaft **308** from rotating in either the clockwise or counterclockwise direction. That is, the frictional force between the clutch mechanism **326** and the ratchet wheel front face **318** is larger than the pulling force exerted by the bowstring **44** on the bowstring cocking rope **50**. As a result, the clutch mechanism **326** prevents the shaft **308** from rotating in a first direction and an opposite direction until a force is exerted on the handle **336** in combination with the pulling force on the bowstring cocking rope **50** is large enough to overcome the frictional force. Thus, once the bowstring **44** is cocked, the user may turn the handle **336** and crank **338** in the clockwise direction to allow the bowstring **44** to rest against the crossbow trigger mechanism (not shown) in the cocked position. Moreover, further rotation in the clockwise direction allows the user to insert slack in the bowstring cocking rope **50** thereby allowing the user to remove the first and second hooks **50***a* and **50***b* from the bowstring **44**. Finally, if the user wishes to move the bowstring **44** from a cocked position into the resting position, the user can also continue to rotate the handle **336** and crank **338** in the clockwise direction to move the bowstring into the resting position without having to fire or dry fire the crossbow.

Bowstring Cocking Device Alternate Embodiment

FIGS. **18** and **19** illustrate an embodiment of a bowstring cocking device **424** that is similar to the bowstring cocking device **324** of FIGS. **15-17**. For purposes of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIGS. **18-19** as compared to the embodiment shown in FIGS. **15-17**. The bowstring cocking device **424** contains a housing body **400**, a shaft **408** having a first square shaped end **408***a* and a second end **408***b* having a first and second rope spool **410** and **412** formed thereon. Similar to the bowstring cocking device **324**, first and second bearings **414** and **416** are received on the shaft **408** to allow the shaft to rotate with respect to the housing body **400**. A sleeve **400** is rotationally fixed to the shaft first end **308***a*. A disk **406**, a ratchet wheel **412**, and first and second springs **430** and **432** are received on, and rotatable with respect to the sleeve **400**. A crank **438** is rotationally fixed to the shaft first end **408***a* and has a handle **436** rotatably coupled thereto by a suitable fastener.

Sleeve

As shown in FIG. **18**, the sleeve **404** is rotationally fixed to the shaft **408** since the sleeve **404** contains a square opening

404*a* that is configured to receive the square shaft first end 408*a* therein. At the end of the sleeve **404** proximate to the first rope spool **410** is a sleeve disk **404***b* that is rotationally fixed to the sleeve **404**. In various embodiments, the sleeve disk **404***b* is integrally formed with the sleeve **404**. In still other embodiments, the sleeve disk **404***b* may be formed separately from the sleeve **404** and fastened to the sleeve using any suitable fastener such as pins, rivets, screws, weldments, etc.

Clutch, Springs, and Ratchet Wheel

Encircling the sleeve **404** is the clutch mechanism **406**, the ratchet wheel **412**, and the first spring **430** and the second spring **432**. The clutch mechanism **406** is positioned intermediate the sleeve disk **404***b* and the ratchet wheel **412**. The second spring **432** is positioned intermediate the ratchet wheel **412** and the first spring **430**. And the first spring **430** is positioned intermediate the second spring **432** and a first cover **402**. The clutch mechanism **406** is generally circular in shape and made from friction-modifying materials (e.g., Kevlar, metal, alloy, semi-metallic material sintered metal, resin, carbon material, or woven glass material). The first spring **430** is concave towards the first cover **402**, while the second spring **432** is concave towards the ratchet wheel **412**.

Detent

A pin **418** is received through the housing body **400** and engages with a spring **420** at the bottom of the housing body **400**. The spring **420** biases the pin **418** radially inward toward the ratchet wheel **412** so that the pin **418** engages the ratchet wheel teeth **412***a* formed on an outer circumferential surface of the ratchet wheel **412** thereby preventing rotation of the ratchet wheel in the counterclockwise direction while allowing the ratchet wheel to rotate in the clockwise direction. When the pin **418** is pulled out against the bias of the spring **420**, the pin **418** no longer engages with the ratchet wheel teeth **412***a* thereby allowing the ratchet wheel to rotate in both the clockwise and counterclockwise direction.

Bowstring Cocking Device Operation

Referring to FIG. **19**, the bowstring cocking device **42.4** is used to pull the bowstring **44** of the crossbow **10** into a cocked position by turning the shaft **408** in the clockwise direction using the handle **436** and crank **438**. As the shaft **408** rotates, the ratchet wheel **412** also rotates in the clockwise direction since it is rotationally fixed to the shaft **408** via the clutch mechanism **406** and the sleeve disk **404***b*. As a result, as the ratchet wheel rotates in the clockwise direction, the pin **418** pops over the ratchet wheel teeth **412***a*. Once the bowstring is moved into the cocked position, the user may rotate the shaft **408** in the counterclockwise direction be applying rotational force to the shaft **408** via the crank **438** and handle **436**. That is, the rotational force applied by the user is sufficient to overcome the frictional force between the ratchet wheel **412**, the sleeve disk **404***b* and the clutch mechanism **406**. Thus, the user can place slack in the bowstring cocking rope to allow the first and second hooks **50***a* and **50***b* to be removed from the bowstring **44**. Once the first and second hooks are removed from the bowstring **44**, the user may rotate the shaft **408** in the clockwise direction once again to take up any remaining bowstring cocking rope **50** so that the first and second hooks are positioned adjacent the housing body **400**. Once the crossbow is fired, the user may pull the pin **418** out of engagement with the ratchet wheel teeth **412***a* so that the first and second hooks **50***a* and **50***b* may be easily pulled from the housing body **400** and hooked onto the bowstring **44**.

If the user wishes to move the bowstring **44** from a cocked position into an un-cocked position, the user may simply apply rotational force to the shaft **408** in the counterclockwise direction so that bowstring cocking rope **50** is wound off the first and second rope spools **410** and **412**. Rotation of the shaft **408** in the counterclockwise direction is controlled by the frictional forces that are exerted between the clutch mechanism **406** and the sleeve disk **404***b* and the frictional forces that are exerted between the clutch mechanism **406** and the ratchet wheel **412**. Thus, if the user releases the handle **436**, the shaft will not spin out of control due to the pulling forces exerted on the shaft **408** by the bowstring **44**.

Fourth Embodiment of Bowstring Cocking Device

FIGS. **20-24** illustrate a fourth embodiment of a bowstring cocking device **524** that is similar to the bowstring cocking device **24** of FIGS. **3-8**. For purpose of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIGS. **20-24**, as compared to the embodiment shown in FIGS. **3-8**.

Bowstring Cocking Device Structure

Referring to FIG. **20**, one embodiment of bowstring cocking device **524** is shown. In particular, the bowstring cocking device **524** comprises a handle **500**, a crank **502**, a housing body **504** having a first cover **506** and second cover **508**, a shaft **510**, a spool body **520**, a ratchet wheel **522**, a gear **542**, and a clutch mechanism **548**.

Housing Body

The first cover **506** and the second cover **508** together enclose the various parts of the bowstring cocking device **524** within the housing body **504**. The housing body **504** is generally cylindrical in shape, but may be formed in any suitable shape. In various embodiments, the housing **504** may be formed from any suitable material (e.g., alloy, stainless steel, ceramic, polymers, etc.), and in particular embodiments, the housing **504** is formed from aluminum. The first cover **506** has a first opening **507***a* and a second opening **507***b* (as shown in FIGS. **21-24**), The inner circumference of the second opening **507***b* is smaller than the inner circumference of the first opening **507***a*.

Shaft

The shaft **510** has a first end **510***a*, a second end **510***b* and a splined portion **512** intermediate the first and second ends **510***a* and **510***b*. The shaft first and second ends **510***a*, **510***b* have a generally smooth outer circumference. The shaft second end **510***b* also has a first and second opening **510***c*, **510***d*. The splined shaft **510** is generally cylindrically shaped with axial splines **512***a* formed on an outer circumference of the shaft intermediate to the first end **510***a* and the second end **510***b* where each axial spline is substantially parallel to the axis of the shaft **510**.

The shaft **510** is rotatably mounted in the housing **504** so that the shaft first end **510***a* extends through the first cover second opening **507***b* and is coupled to a first cap **514** by a first cap screw **514***a*. In various embodiments, the shaft first end **510***a*. may be integrally formed with the first cap **514**, or in other embodiments, the shaft first end **510***a* may be connected to the first cap **514** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.). In addition, the shaft second end **510***b* extends through the second cover **508** and is coupled to a second cap **515** by a second cap screw **515***a*. In various embodiments, the shaft second end **510***b* may be integrally formed with the second cap **515**, or in other embodiments, the shaft second end **510***b* may be connected to the second cap using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.).

The shaft splines **512***a* are configured to interact with a splined ring **516**, a splined inner circumferential bore **536** of the rope spool body **520**, and a splined inner circumferential surface **522***a* of the ratchet wheel **522**. The second end **510***b* of the shaft **510** is configured to receive a disk **518**, the splined

ring **516**, the clutch mechanism **548**, a washer **523**, the first spring **526**, and the second spring **528**.

Rope Spool Body

The rope spool body **520** comprises a first end **520***a* and a second end **520***b*. The rope spool body **520** is generally cylindrical in shape and has a first rope spool **532** and a second rope spool **534**. The rope spools **532**, **534** provide a space for the bowstring cocking rope **50** to wind around when the bowstring **44** is pulled from the resting position into the cocked position. The rope spool body **520** is received on, axially moveable with respect to, and rotationally fixed to the shaft **510** by the splined bore **536**. The outer circumference of the rope spool body first end **520***a* is generally circular with a hexagonally shaped end **521**. In addition, the rope spools **532** and **534** are configured to operatively attach to a first and a second end of the bowstring cocking rope **50**. Referring to FIG. **21**, a first opening **524** and a second opening **526** in the housing body **504** are positioned above the first rope spool **532** and the second rope spool **534**, respectively, and allow the cocking rope **50** (not shown) to enter the housing body **504** and wind around the rope spools **532**, **534**.

Gear

Referring again to FIG. **20**, the gear **542** has a generally hexagonal inner circumference **544** that is configured to operatively engage with the rope spool body hexagonally shaped end **521** to rotationally fix the rope spool body **520** to the gear **542** That is, the gear inner circumference **544** and rope spool body hexagonally shaped end **521** are both substantially hexagonal in shape where the gear inner circumference **544** is slightly larger than the rope spool body hexagonally shaped end **521**. In various embodiments, the gear **542** may be integrally formed with the rope spool body **520**. In still other embodiments, the gear **542** may be rotationally fixed to the shaft **510** via a splined engagement similar to the splined engagement between the rope spool body **520** and the shaft splines **512***a*.

Ratchet Wheel and Detent

The ratchet wheel **522** is positioned intermediate the first cover **506** and the gear **542**. The ratchet wheel **522** has (1) the splined inner circumference surface **522***a* and is received on the shaft splined portion **512**, and (2) a toothed outer circumferential surface **522***b*. The ratchet wheel **522** is positioned on the shaft **510** proximate to the shaft first end **510***a*. A detent **546** is operatively received in the housing **504** such that one end of the detent **546** may be moved into and out of engagement with the ratchet wheel toothed outer circumferential surface **522***b* to prevent unwanted rotation of the ratchet wheel **522** in one direction.

A pin **545** is received through the detent **546** and is received in the housing body **504**. The pin **545** allows the detent to pivot into an out of engagement with the ratchet wheel teeth **522***b*. A spring **547** mounted intermediate the housing body and the detent **546** biases the detent **546** radially inward toward the ratchet wheel **522** so that the detent **546** engages the ratchet wheel teeth **522***a* thereby preventing rotation of the ratchet wheel in the counterclockwise direction while allowing the ratchet wheel **522** to rotate in the clockwise direction. When the detent **546** is rotated outward, the detent **546** no longer engages with the ratchet wheel teeth **522***a* thereby allowing the ratchet wheel to rotate in both the clockwise and counterclockwise direction.

Clutch Mechanism

The clutch mechanism **548** is received on the shaft **510** adjacent the shaft second end **510***b*. The clutch **548** is also received in, and rotationally fixed to, the second cover **508**. That is, the second cover **508** contains a substantially square recess that receives the substantially square clutch mechanism **548** so that the clutch mechanism is rotationally fixed to the second cover **508** and the housing **504**. It should be understood that the clutch mechanism **548** may be rotationally fixed to the second cover **508** by other suitable means. The clutch **548** has a smooth, circular inner circumferential surface **550** for receiving the shaft second end **510***b*. In various embodiments, the clutch **548** is generally square shaped and made from friction-modifying materials (e.g., Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material).

Crank Shaft, Gear and Handle

Still referring to FIG. **20**, the handle **500** is coupled to a first end **502***a* of the crank **502**. In various embodiments, the crank **502** may be connected to the handle **500** using any suitable fastener (e.g., a bolt, a pin, a rivet, weldments, etc.), The crank **502** and the handle **500** are generally perpendicular to each other when attached. The crank **502** also has a second end **502***b* with an opening **502***c* that is configured to operatively engage with a gear crank shaft **511**. The gear crank shaft **511** is rotationally fixed to the crank **502** since the shape of the crank opening **502***c* matches the shape of an end **511***a* of the gear crank shaft **511**. That is, the crank opening **502***c* and the end **511***a* of the gear crank shaft **511** are both substantially square in shape. In various embodiments, the crank **502** may be coupled to the gear rank shaft **511** in any suitable manner (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.).

The gear crank shaft **511** is operatively coupled to a crank gear **513** so that the gear crank shaft is rotationally fixed to the crank gear **513**. In various embodiments, the crank gear **513** is integrally formed with the gear crank shaft **511**. In various other embodiments, the crank gear **513** may be connected to the gear crank shaft **511** using any suitable fastener (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.). The crank gear **513** has teeth that match the teeth of the gear **542**.

Parts Enclosed Inside the Housing Body

Referring to FIG. **21**, when the bowstring cocking device is assembled, the following parts fit inside the housing body **504** beginning at the first cover **506** and progressing along to the second cover **508**: the ratchet wheel **522**, the gear **542**, the rope spool body **520**, the disk **518**, the splined ring **516**, the clutch mechanism **548**, the washer **523**, the first spring **526**, and the second. spring **528** and running through the length of the inner circumference of each of these parts is the shaft **510**.

Bowstring Cocking Device Operation

First Position

Referring to FIGS. **21** and **23**, the bowstring cocking device **524** is shown in a first position where the shaft **510** is moved axially into a first position with respect to the housing body **504** such that the splined portion **512** is engaged with the ratchet wheel splined inner circumferential surface **522***a* and is disengaged from the splined ring **516**. In the first position, the splined ring **516** is positioned on the smooth surface of the shaft second end **510***b*. The bowstring cocking device **524** may be moved into the first position as shown in FIGS. **21** and **23** by pushing the second cap **515** axially toward to the first cover **506**. Because the second cap **515** is coupled to the shaft **510**, moving the second cap **515** axially toward the first cover **506** causes the shaft **510** to move axially (toward the right with regard to FIG. **21**) so that the splined portion **512** engages with the inner circumferential splined surface **522***a* of the ratchet wheel **522**, which causes the ratchet wheel **522** to be rotationally fixed with the shaft **510** while the splined ring **516** is allowed to rotate with respect to the shaft **510**.

Referring again to FIG. **20**, the teeth of the crank gear **513** engage with the teeth of the gear **542** so that rotation of the crank gear **513** in the clockwise direction causes the gear **542** to rotate in a counterclockwise direction (with respect to the

view of FIG. **23**). Thus when the crank **502** is turned clockwise, the gear crank shaft **511** also rotates clockwise in turn causing the crank gear **513** to rotate clockwise. This, in turn, rotates the gear **542** in the opposite, counter-clockwise, direction. Because the gear **542** is rotationally fixed to the shaft **510** via the spool body **520**, and the ratchet wheel **522** and the spool body **520** are rotationally fixed to the shaft **510**, rotation of crank **502** and crank shaft **511** clockwise causes the spool body **520** to rotate counterclockwise. As a result, as the rope spool body **520** rotates counterclockwise, it winds up the bowstring cocking rope **50** and pulls the bowstring **44** into the cocked position. Because the spring **547** biases the detent **546** into the ratchet wheel toothed outer circumferential surface **522***b*, the detent **546** prevents unwanted rotation of the ratchet wheel **522** in the clockwise direction. As a result, the spool body **520** is also prevented from rotating in the clockwise direction since the ratchet wheel **522** and the spool body **520** is rotationally fixed to the shaft **510**. In this way, the spool body **520** will not inadvertently rotate clockwise in response to the bias exerted on the bowstring cocking rope **50** by the bowstring **44**.

Second Position

FIGS. **22** and **24** show the shaft **510** in a second position where the shaft splined portion **512** is disengaged from the ratchet wheel **522** and is engaged with the splined ring **516**. In the second position, either the bowstring cocking rope **50** may be slightly released so that the first and second hooks **50***a* and **50***b* may be removed from the bowstring **44** once the bowstring is in the cocked portion, or (2) the bowstring **44** may be moved from the firing position into the resting position without firing or dry firing the crossbow **10**. The bowstring cocking device is moved into the second position when the user pushes the first cap **514** axially away from the first cover **506**, causing the shaft **510** to move axially rearward (e.g., to the left in FIG. **22**) so that the shaft splined portion **512** engages the splined ring **516** and disengages from the splined ratchet wheel **522**. Because the inner circumference of the first cover second hole **507***a* is larger than the outer circumference of the shaft first end **510***a* but smaller than the outer circumference of the first cap **514**, the shaft moves axially through the second hold **507***a* and the first cap **514** functions as a stop to prevent the user from pushing the first cap **514** through the first cover **506**.

Thus, when the bowstring cocking device **524** is in the second position, the ratchet wheel **522** no longer prevents the shaft **510** from rotating in the clockwise direction since the ratchet wheel **522** is no longer rotationally fixed to the shaft **510**. Instead, the engagement of a face of the splined ring **516** with a face of the clutch mechanism **548** prevents the shaft **510** from spinning freely. That is, the frictional force between the face of the splined ring **516** and the corresponding face of the clutch mechanism **548** is greater than the pulling force exerted on the bowstring cocking rope **50** by the bowstring **44**. As a result, the shaft remains rotationally fixed to the housing through the clutch mechanism **548** until the user exerts sufficient force on the shaft to overcome the frictional force by turning the handle **500** and the crank **502** in the counterclockwise direction, which in turn causes the shaft **510** to rotate in the clockwise direction, thereby letting the bowstring cocking rope **50** out from the rope spools **532**, **534**. In this way, the user can either release tension on the bowstring cocking rope to allow the user to remove the first and second hooks **50***a* and **50***b* (not shown) from the bowstring **44** or to release the bowstring **44** from the cocked position into the resting position in a controlled manner without firing or dry firing the crossbow.

Fourth Embodiment of Bowstring Cocking Device

FIGS. **25-27** illustrate an embodiment of a bowstring cocking device **624** that is similar to the bowstring cocking device **424** of FIGS. **18-19**. For purposes of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIGS. **25-27** as compared to the embodiment shown in FIGS. **18-19**. Referring particularly to FIG. **25**, the bowstring cocking device **624** contains a first housing body **600**, a second housing body **602**, a first rope spool body **604** having a first substantially square shaped end **604***a* and a first rope spool **606**. The bowstring cocking device **624** also contains a second rope spool body **608** having (1) a first generally rectangular shaped end **608***a*, (2) a second generally square shaped end **608***b*, and (3) a second rope spool **610** formed thereon intermediate the shaft first and second ends **608***a*, **608***b*. Together, the first and second rope spool bodies form a shaft **607** that comprises the first rope spool body **604** and the shaft first and second ends **608***a* and **608***b*. Similar to the bowstring cocking device **424**, a first and a second bearing **612** and **616** are respectively received on the first and second rope spool bodies **604**, **608** to allow the rope spool bodies **604**, **608** to rotate with respect to the housing bodies **600**, **602**, respectively. A sleeve **614** attached to a ring **618** are rotationally fixed to the second rope spool body first end **608***a*, as described below. A clutch mechanism **620**, a ratchet wheel **622**, a first spring **624** and a second spring **626** are received on, and is rotatable with respect to the sleeve **614** and sleeve ring **618**. A crank **628** (1) is rotationally fixed to the first rope spool body first end **604***a* and (2) has a handle **630** rotatably coupled thereto by a suitable fastener.

Sleeve

Still referring to FIG. **25**, the sleeve **614** and sleeve ring **618** are rotationally fixed to the second rope spool body **608** since the sleeve **618** contains a generally square opening **632** that is configured to receive the generally square shaped second rope spool body first end **608***a* therein. At the end of the sleeve **614** proximate to the first rope spool **606** is the sleeve disk **618** that is rotationally fixed to the sleeve **614**. In various embodiments, the sleeve disk **618** is integrally formed with the sleeve **614**. In still other embodiments, the sleeve disk **618** may be formed separately from the sleeve **614** and fastened to the sleeve **614** using any suitable fastener such as pins, rivets, screws, weldments, etc.

Clutch, Springs, and Ratchet Wheel

Encircling the sleeve **618** is the clutch mechanism **620**, the ratchet wheel **622**, the first spring **624** and the second spring **626**. The ratchet wheel **622** has a toothed outer circumference **622***a*. The clutch mechanism **620** is positioned intermediate the sleeve disk **618** and the ratchet wheel **622**. The ratchet wheel **622** is positioned intermediate the sleeve disk **618** and the first spring **624**. The first spring **624** is positioned intermediate the ratchet wheel **622** and the second spring **626**. And the second spring **626** is positioned intermediate the first spring **624** and the second rope spool **610**. The clutch mechanism **620** is generally circular in shape and made from friction-modifying materials Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material), The first spring **624** is concave towards the second spring **626**, while the second spring **626** is concave towards the first spring **624**.

Detent

Referring to FIG. **26**, a detent **636** is received through the second housing body **602** and engages with a spring **638** at the bottom of the second housing body **602**. The spring **638** biases a first end **636***a* of the detent **636** radially outward which in turn causes the second end **636***b* of the detent **636** to

move radially inward toward the ratchet wheel **622** so that the detent second end **636***b* engages the ratchet wheel teeth **622***a* thereby preventing rotation of the ratchet wheel **622** in the counterclockwise direction while allowing the ratchet wheel **622** to rotate in the clockwise direction. When the detent first end **636***a* is pushed radially inward against the bias of the spring **638**, the detent second end **636***b* moves radially outward so that it no longer engages with the ratchet wheel teeth **622***a* thereby allowing the ratchet wheel **62.2** to rotate in both the clockwise and counterclockwise direction.

Bowstring Cocking Device Operation

Referring to FIG. **27**, the bowstring cocking device **624** is used to pull the bowstring **44** of the crossbow **10** into a cocked position by turning the shaft **607** in the clockwise direction using the handle **630** and crank **628**. As the shaft **607** rotates, the ratchet wheel **622** also rotates in the clockwise direction since it is rotationally fixed to the shaft **607** via the clutch mechanism **620** and the sleeve disk **618**. As a result, as the ratchet wheel **622** rotates in the clockwise direction, the detent second end **638***b* pops over the ratchet wheel teeth **622***a*. Once the bowstring is moved into the cocked position, the user may rotate the shaft **607** in the counterclockwise direction by applying rotational force to the shaft **607** via the crank **628** and handle **630**. That is, the rotational three applied by the user is sufficient to overcome the frictional force between the ratchet wheel **622**, the sleeve disk **618** and the clutch mechanism **620**. Thus, the user can place slack in the bowstring cocking rope **50** to allow the first and second hooks **50***a* and **50***b* to be removed from the bowstring **44**. Once the first and second hooks are removed from the bowstring **44**, the user may rotate the shaft **607** in the clockwise direction once again to take up any remaining bowstring cocking rope **50** so that the first and second hooks **50***a* and **50***b* are positioned adjacent the housing bodies **600**, **602**. Once the crossbow **10** is fired, the user may push the detent first end **636***a* so that the detent second end **636***b* moves out of engagement with the ratchet wheel teeth **622***a* so that the first and second hooks **50***a* and **50***b* may be easily pulled from the housing bodies **600**, **602** and hooked onto the bowstring **44**.

If the user wishes to move the bowstring **44** from a cocked position into an un-cocked position, the user may simply apply rotational force to the shaft **607** in the counterclockwise direction so that bowstring cocking rope **50** is wound off the first and second rope spools **606** and **610**. Rotation of the shaft **607** in the counterclockwise direction is controlled by the frictional forces that are exerted between the clutch mechanism **620** and the sleeve disk **618** and the frictional forces that are exerted between the clutch mechanism **620** and the ratchet wheel **622**. Thus, if the user releases the handle **630**, the shaft **607** will not spin out of control due to the pulling forces exerted on the shaft **607** by the bowstring **44**.

It should be understood to one of skill in the art that by placing the ratchet wheel, the clutch mechanism and the sleeve disk intermediate the first and second spools, the overall size of the bowstring cocking device can be reduced.

Bowstring Cocking Device Alternate Embodiment

Referring to FIGS. **28-30** an alternative embodiment of a bowstring cocking device **724** is shown having a dual shaft design as opposed to the single shaft design shown in the bowstring cocking device **624** embodiment of FIGS. **25-27**. Thus, for purposes of ease of understanding and clarity, only certain parts will be discussed to highlight the differences in the structure and operation of the embodiment shown in FIGS. **28 30** as compared to the embodiment shown in FIGS. **25-27**.

Handle and Crank

The handle **700** and crank shaft **702** are coupled to a gear shaft **704**. That is, the crank second end **702***b* contains a square opening **702***c* that mates with, and is rotationally fixed to, a first end **704***a* of the shaft **704**. Additionally, this alternate embodiment utilizes a bolt that runs the length of the second rope spool body **708** that is used to secure the second rope spool body to the first rope spool body.

Housing Bodies and Rope Spool Bodies

The bowstring cocking device **724** contains a first housing body **710**, a second housing body **712**, a first rope spool body **714** having a first substantially square shaped end **714***a*, a second substantially square shaped end **714***b*, and a first rope spool **716**. The bowstring cocking device **724** also contains the second rope spool body **708** having a first end **708***a* and a second end **708***b*, and having a second rope spool **718** formed thereon intermediate the second rope spool body first and second ends **708***a*, **708***b*. The second rope spool body **708** has a generally square shaped inner circumference **708***c*. The first rope spool body second end **714***b* is received by the second rope spool body inner circumference **708***c* so that the first and second rope spool bodies are rotationally fixed to one another. Also received on the first rope spool body second end **714***b* is a clutch mechanism **720**, a sleeve **722**, a ratchet wheel **725**, a first spring **726**, and a second spring **728**. When the first rope spool body second end **714***b* is received in the second rope spool body inner circumference **708***c*, the first and second rope spool bodies together define a shaft **730**. Similar to the bowstring cocking device **624**, first and second bearings **732**, **734** are received on the first and second rope spool bodies **714**, **708** to allow the rope spool bodies **714**, **708** to rotate with respect to the housing bodies **710**, **712**.

Sleeve

As shown in FIG. **25**, the sleeve **722** is rotationally fixed to the first rope spool body **714** since the sleeve **722** contains a generally square opening **722***a* that is configured to receive the square first rope spool body first end **714***b* therein. At the end of the sleeve **722** intermediate the clutch mechanism **720** and the ratchet wheel **725** is a sleeve disk **736** that is rotationally fixed to the sleeve **722**. The ratchet wheel **725**, and the first and second springs **726**, **728** are received on, and rotatable with respect to the sleeve **722**. In various embodiments, the sleeve disk **736** is integrally formed with the sleeve **722**. In still other embodiments, the sleeve disk **736** may be formed separately from the sleeve **722** and fastened to the sleeve **722** using any suitable fastener such as pins, rivets, screws, weldments, etc.

Clutch, Springs, and Ratchet Wheel

Encircling the first spool body second end **714***b* is the sleeve disk **736** and the sleeve **722**. The clutch **720** and the ratchet wheel **725** are received on the sleeve **722**, That is, the clutch **720** is positioned intermediate the sleeve disk **736** and the ratchet wheel. Also encircling the sleeve **722** is the first spring **726** and the second spring **728**, which are positioned intermediate the second rope spool body **708** and the ratchet wheel **725**. The ratchet wheel **725** has a toothed outer circumference **725***a*. The clutch mechanism **720** is generally circular in shape and made from friction-modifying materials (e.g., Kevlar, metal, alloy, semi-metallic material, sintered metal, resin, carbon material, or woven glass material). The first spring **726** is concave towards the second spring **728**, while the second spring **728** is concave towards the first spring **726**.

Gear, Crank Gear, and Crank Gear Shaft

Still referring to FIG. **28**, the crank second end opening **702***c* is configured to operatively engage with a gear crank shaft **704**. The gear crank shaft **704** is rotationally fixed to the crank **702** since the shape of the crank opening **702***c* matches

the shape of an end **704***a* of the gear crank shaft **704**. That is, the crank opening **702***c* and the gear crank shaft end **704***a* are both substantially square in shape. In various embodiments, the crank **702** may be coupled to the gear crank shaft **704** in any suitable manner (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.).

The gear crank shaft **704** is operatively coupled to a crank gear **705** so that the gear crank shaft **704** is rotationally fixed to the crank gear **705**. In various embodiments, the crank gear **705** is integrally formed with the gear crank shaft **704**. In various other embodiments, the crank gear **705** may be connected to the gear crank shaft **704** using any suitable fastener (e.g., a bolt, a pin, a rivet, a cotter pin, weldments, etc.). The crank gear **705** has teeth that match the teeth of a gear **738**. The gear **738** has a substantially square inner circumference to receive the first rope spool body first end **714***a* so that the first rope spool body **714** is rotationally fixed to the gear **738**.

Bowstring Cocking Device Operation

Referring to FIG. **29**, the bowstring cocking device **724** is used to pull the bowstring **44** of the crossbow **10** (FIG. **1**) into a cocked position by turning the crank shaft **702** in the clockwise direction using the handle **700**. Referring again to FIG. **28**, the teeth of the crank gear **70** engage with the teeth of the gear **738** so that rotation of the crank gear **705** in the clockwise direction (with respect to FIG. **29**) causes the gear **738** to rotate in a counterclockwise direction. Thus when the crank **702** is turned clockwise, the gear crank shaft **704** also rotates clockwise in turn causing the crank gear **705** to rotate clockwise. This, in turn, rotates the gear **738** in the opposite, counter-clockwise, direction. Because the gear **738** is rotationally fixed to the first rope spool body **714** and the second rope spool body **708** is rotationally fixed to the first rope spool body **714**, rotation of the crank **702** and the gear crank shaft **704** clockwise causes the first and second spool bodies **714**, **708** to rotate counterclockwise. As a result, as the rope spool bodies **714**, **708** rotate counterclockwise, they wind up the bowstring cocking rope **50** and pull the bowstring **44** into the cocked position. The overall operation of the bowstring cocking device **724** is substantially similar to the bowstring cocking device **624** and a detailed description is omitted for brevity.

Conclusion

In all of the various embodiments described above, various clutch mechanism are used to control the rotation of a shaft in a bowstring cocking device. As such, frictional forces between a disk that is rotationally fixed to the shaft and a clutch mechanism that is either (1) rotationally fixed to a housing body or (2) positioned intermediate to a ratchet wheel and a disk rotationally fixed to the shaft help to control the rotation of the shaft when force is exerted on the shaft by the bowstring. The various configurations also allow the user to either (1) provide slack in the bowstring cocking rope so that the user can remove the hooks connecting the bowstring cocking rope to the bowstring, or (2) move the bowstring from a cocked position into an un-cocked position without the user firing or dry firing the crossbow.

What is claimed:

1. A crossbow drawing mechanism for use with a crossbow, the crossbow drawing mechanism comprising:

a. a housing having a cavity formed therein;

b. a first shaft positioned at least partially in the housing cavity and rotatable with respect to the housing, the first shaft comprising:

i. a first end, and

ii. a second end,

c. a first spool rotatably fixed to the first shaft proximate the first shaft first end and positioned in the housing cavity;

d. a second spool rotatably fixed to the first shaft intermediate the first spool and the first shaft second end and positioned in the housing cavity;

e. a ratchet wheel received on the first shaft intermediate the first spool and the second spool, wherein the ratchet wheel is rotatable with respect to the first shaft and the ratchet wheel comprising a plurality of teeth that are adapted to receive a pawl for rotationally fixing the ratchet wheel to the housing; and

f. a crank operatively coupled to the first shaft such that when the crank is rotated the shaft rotates,

wherein the ratchet wheel rotationally fixes the first shaft to the housing in a first direction and allows the shaft to rotate with respect to the housing in an opposite second direction.

2. The crossbow drawing mechanism of claim **1**, further comprising a clutch positioned intermediate the ratchet wheel and one of the first spool and the second spool, wherein:

the clutch rotationally fixes the ratchet wheel to the first shaft.

3. The crossbow drawing mechanism of claim **2**, wherein the clutch further comprises:

a. a sleeve that is rotationally fixed to the first shaft;

b. a clutch disc positioned intermediate the ratchet wheel and the sleeve; and

c. at least one spring positioned intermediate the second spool and the ratchet wheel,

wherein the clutch disc is compressed between the ratchet wheel and the sleeve.

4. The crossbow drawing mechanism of claim **1**, further comprising a pawl rotatably coupled to the housing so that a portion of the pawl is releasably engaged with the teeth formed on a periphery of the ratchet wheel.

5. The crossbow drawing mechanism of claim **1**, further comprising a second shaft at least partially received in the housing, wherein

a. the second shaft is operatively coupled to the first shaft;

b. the crank is coupled to the second shaft;

c. rotation of the crank in the first direction causes the first shaft to rotate in the second direction and rotation of the crank in the second direction causes the first shaft to rotate in the first direction.

6. The crossbow drawing mechanism of claim **1**, wherein the crank is directly coupled to the first shaft first end.

7. A crossbow drawing mechanism for use with a crossbow, the crossbow drawing mechanism comprising:

a. a generally cylindrical housing;

b. a shaft positioned at least partially within the generally cylindrical housing and rotatable with respect to the housing, the shaft comprising:

i. a first end, and

ii. a second end,

c. a first spool rotatably fixed to the shaft;

d. a second spool rotatably fixed to the shaft and spaced apart from the first spool;

e. a ratchet wheel received on the shaft intermediate the first spool and the second spool, wherein the ratchet wheel is rotatable with respect to the shaft and comprises a plurality of teeth that are adapted to receive a pawl for rotationally fixing the ratchet wheel to the housing; and

f. a clutch positioned intermediate the first spool and the second spool such that the clutch rotationally fixes the ratchet wheel to that shaft;

wherein

i. when the shaft is rotated in a first direction, the ratchet wheel prevents the shaft from rotating with respect to the housing, and

ii. when the shaft is rotated in an opposite second direction, the ratchet wheel rotates in the second direction with the shaft.

8. The crossbow drawing mechanism of claim **7**, wherein when a sufficient force is exerted on the shaft in the first direction, the shaft rotates with respect to the housing in the first direction.

9. The crossbow drawing mechanism of claim **7**, further comprising a handle coupled to the first end of the shaft.

10. The crossbow drawing mechanism of claim **7**, further comprising a pawl coupled to the housing, wherein a portion of the pawl engages with the plurality of teeth formed on the outer periphery of the ratchet wheel to rotationally lock the ratchet wheel to the housing to prevent the shaft from rotating in the first direction while allowing the shaft to rotate in the second direction.

11. The crossbow drawing mechanism of claim **7**, wherein the clutch further comprises a clutch disk positioned intermediate the ratchet wheel and one of the first spool and the second spool, wherein the clutch disk rotationally fixes the ratchet wheel to the one of the first spool or the second spool.

12. The crossbow drawing mechanism of claim **7**, wherein the clutch further comprises:

a. a sleeve received on the shaft intermediate the ratchet wheel and one of the first spool or the second spool;

b. a clutch disk positioned intermediate the sleeve and the ratchet wheel; and

c. at least one spring positioned intermediate the one of the first spool or the second spool and the ratchet wheel,

wherein

i. the sleeve is rotationally fixed to the shaft, and

ii. the clutch disk rotationally fixes the ratchet wheel to the shaft via the sleeve.

13. The crossbow drawing mechanism of claim **12**, wherein one of the ratchet wheel or the sleeve is axially moveable with respect to the shaft.

14. The crossbow drawing mechanism of claim **7**, further comprising:

a. a second shaft rotatably mounted in the housing, the second shaft having a first end and an opposite second end;

b. a handle coupled to the second shaft first end;

wherein

the second shaft is operatively coupled to the shaft,

when the handle is rotated in the first direction, the second shaft rotates in the first direction and the shaft rotates in the second direction, and

when a sufficient force is exerted on the handle in the second direction, the second shaft rotates in the second direction and the shaft rotates in the first direction with respect to the ratchet wheel.

15. A crossbow and a crossbow drawing mechanism comprising:

a. an elongated body;

b. a first limb coupled to a first end of the elongated body;

c. a second limb coupled to the elongated body first end;

d. a bowstring having a bowstring first end operatively coupled to the first limb and a bowstring second end operatively coupled to the second limb;

e. a crossbow drawing mechanism comprising:

i. a housing coupled to the elongated body distal from the first end,

ii. a first shaft having a first end and a second end, wherein at least a portion of the first shaft is rotatably mounted in the housing,

iii. a first spool mounted on the first shaft proximate the first end of the first shaft and rotatably fixed to the first shaft,

iv. a second spool mounted on the first shaft intermediate the first spool and the second end of the first shaft and rotatably fixed to the first shaft,

v. a ratchet wheel rotatably mounted on the first shaft intermediate the first spool and the second spool, the ratchet wheel comprising a plurality of teeth that are adapted to receive a pawl for rotationally fixing the ratchet wheel to the housing; and

vi. a clutch mounted on the first shaft intermediate one of the first spool or the second spool and the ratchet wheel,

wherein the clutch and the ratchet wheel rotationally fix the shaft to the housing in a first direction and allow the shaft to rotate with respect to the housing in an opposite second direction.

16. The crossbow and the crossbow drawing mechanism of claim **15**, further comprising a pawl pivotally mounted to the housing such that a portion of the pawl is operatively engaged with the plurality of teeth formed on a periphery of the ratchet wheel.

17. The crossbow and the crossbow drawing mechanism of claim **16**, further comprising a second shaft rotatably mounted in the housing and operatively coupled to the first shaft by a gear, wherein

a. the crank is coupled to the second shaft,

b. when the crank is rotated in the first direction, the second shaft rotates in the first direction and the first shaft rotates in the second direction, and

c. when the pawl is rotated with respect to the housing, the pawl disengages from the ratchet wheel so that when the crank is rotated in the second direction, the second shaft rotates in the second direction and the first shaft rotates in the first direction.

18. The crossbow and the crossbow drawing mechanism of claim **15**, the clutch further comprising:

a. a sleeve rotatably fixed to the first shaft and positioned intermediate the ratchet wheel and the one of the first spool or the second spool; and

b. a clutch disc rotatably mounted on the first shaft intermediate the sleeve and the ratchet wheel,

wherein the clutch disk rotationally fixes the ratchet wheel to the first shaft via the sleeve.

19. The crossbow and the crossbow drawing mechanism of claim **15**, further comprising a crank operatively coupled to the first shaft.

20. The crossbow and the crossbow drawing mechanism of claim **18**, further comprising a second shaft rotatably mounted in the housing and operatively coupled to the first shaft by a gear, wherein

a. a crank is coupled to the second shaft,

b. when the crank is rotated in the first direction, the second shaft rotates in the first direction and the first shaft rotates in the second direction, and

c. when a sufficient force is applied to the crank in the second direction, the second shaft rotates in the second direction and the first shaft rotates in the first direction against the frictional force exerted between a sleeve and the ratchet wheel.

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